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REVIEW OF FEDERAL STUDIES ON HEALTH EFFECTS OF LOW-LEVEL RADIATION EXPOSURE AND IMPLEMENTATION OF PUBLIC LAW 97-72

HEARING

BEFORE THE

SUBCOMMITTEE ON
OVERSIGHT AND INVESTIGATIONS

OF THE

COMMITTEE ON VETERANS' AFFAIRS
HOUSE OF REPRESENTATIVES

NINETY-EIGHTH CONGRESS

FIRST SESSION

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REVIEW OF FEDERAL STUDIES ON HEALTH EFFECTS OF LOW-LEVEL RADIATION EXPOSURE AND IMPLEMENTATION OF PUBLIC LAW 97-72

TUESDAY, MAY 24, 1983

House of Representatives,
Subcommittee on Oversight and Investigations,
Committee on Veterans' Affairs,
Washington, D.C.

The subcommittee met, pursuant to notice, at 8:30 a.m., in room 334, Cannon House Office Building, Hon. G. V. (Sonny) Montgomery (chairman of the subcommittee) presiding.

Present: Representatives Montgomery, Penny, Staggers, Rowland, Evans, Sundquist, and Johnson.

Also present: Representatives Edgar and Daschle, members of the full Committee on Veterans' Affairs.

OPENING STATEMENT OF HON. G. V. (SONNY) MONTGOMERY

Mr. Montgomery. Good morning, the subcommittee will come to order.

We meet this morning to review the activities of Federal agencies which are conducting scientific studies and investigations into the health effects of low-level radiation exposure experienced by certain veterans; the Defense Nuclear Agency's reconstruction of exposure levels of nuclear test participants; and the VA's implementation of Public Law 97-72, the Veterans' Health Care, Training, and Small Business Loan Act of 1981.

We will receive testimony during this hearing from the Federal agencies concerned with this matter, as well as representatives from the National Association of Atomic Veterans and other veterans organizations.

As many of us are aware, beginning in 1945 and continuing until 1963, the U.S. Government exploded approximately 235 nuclear weapons in the atmosphere over the American Southwest and Pacific Ocean. The Department of Defense estimates that approximately 220,000 personnel participated in those tests. Additional personnel may have been exposed while in the occupation forces in Japan after the atomic bombings of Hiroshima and Nagasaki in 1945. Many of these troops were exposed to low-level ionizing radiation which may or may not have been accurately documented with proper exposure devices or methodologies. To compound the problem, there is limited scientific understanding of the relationship between exposure to low doses of ionizing radiation and subsequent health problems.

To assist these veterans who may have been exposed to radiation and who are suffering from illnesses that may have been caused by such exposure, the Congress enacted Public Law 97-72. This law authorizes the VA to provide certain health care services to these veterans for illnesses not found to be a result of other causes.

Public concern about the health effects of low-level ionizing radiation has been heightened in recent years by the results of several studies.

Since 1902, when cancer was first attributed to overexposure to X-rays, the U.S. Government has spent close to $2 billion (approximately $80 million per year in recent years) on research on the health effects of ionizing radiation. At least 80,000 scientific papers on the subject have been published worldwide. While much has been learned about the carcinogenic effects of high doses of radiation exposure, scientists still are uncertain how ionizing radiation causes cancer, and how to predict the effects of exposure to low doses of ionizing radiation.

Given the many sources of ionizing radiation in our environment, it has become increasingly important to answer these questions for our veteran population.

While there is as yet no way to determine precisely the health risks of exposure to low-level ionizing radiation, and it is unlikely that this question will be resolved soon, there is a continuing need for federally sponsored research in this area. The Subcommittee on Oversight and Investigations feels that these research efforts should be intensified and coordinated in order to derive timely and reliable answers to this issue.

The Interagency Radiation Research Committee was established by Presidential memorandum under President Carter. However, because of the importance of this issue, we might consider the recommendation of the General Accounting Office to introduce legislation giving satutory authority to this interagency committee to coordinate and strengthen Federal research on the health effects of ionizing radiation exposure. Such a committee could establish research priorities to help insure that promising ideas are funded, that unnecessary duplication of effort is avoided, and that limited Federal research funds are spent effectively.

It is my understanding in conversations with the spokesmen of the service organization that represents the veterans who were exposed to ionizing radiation that one of their major concerns is the lack of a line of communication between Federal agencies, scientific organizations and the exposed veterans to provide a forum for sharing their thoughts and opinions on this important issue. I believe that we should look into possible ways that this line of communication could be established.

I have received several letters concerning this important subject with requests that they be made part of this hearing record.[1] Additionally, the American Legion has submitted a statement for inclusion in the record.[2] Without objection. I will place them in the record at this time.

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[1] See p. 384.

[2] See p. 443.

Mr. Hillis will be in at a later date. He is the ranking minority member on this committee.

Today we operating under the 5-minute rule for both witnesses and also committee members. We have a number of witnesses this morning and we certainly hope that the witnesses will cooperate with the Chair. Of course, if you have strong points that you would like to make, the Chair will extend the time, but your full statement will be put in the record.

We would like to have our first witness come forward and take a seat at the witness stand.

Paul Simon is certainly a good friend of this committee from Illinois, southern Illinois. I had the privilege of going to his congressional district about 1½ years ago and met with veterans organizations from Paul's district. In fact, it is one of the largest gatherings that I have ever been to pertaining to veterans and veterans talking about their problems.

Paul, we certainly welcome you to testify before this committee this morning and and thank you for being here.

Mr. SIMON. I thank you very much, Mr. Chairman.

Let me thank you once again for coming to southern Illinois. They are still talking about that in southern Illinois.

Mr. MONTGOMERY. I might say that Paul's district in southern Illinois is closer to part of my district in Mississippi than Paul is to Chicago. If I'm wrong on that, go ahead and correct me for the record.

Mr. SIMON. That is correct. In fact, my district in Illinois is south of Louisville and south of Richmond. Most people have a hard time believing that Illinois stretches that long.

STATEMENT OF THE HON. PAUL SIMON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS

Mr. SIMON. Mr. Chairman and members of the committee, I was visited, I guess now maybe it's 2½ to 3 years ago, by three veterans who came to me with a special story, and unitl then I was unaware of this whole problem.

Let me illustrate it by giving you one dramatic story. It is a story of a young man, Bob Farmer from Steeleville, Ill., who at the age of 19 was in the Navy and stationed in the South Pacific at the time of two of our nuclear tests. When the explosions took place they shielded themselves the best they could and when it was over, they went out and they played in the ocean and on the beach. One of his jobs was to wash down the boats that had been right in the target area of the test and it was not done maliciously by the Navy or by those supervising the tests. People were just not aware of the problem.

Now, in the meantime, Bob Farmer comes home to his little rural town in southern Illinois, gets married, has a family. Bob Farmer himself now has heart trouble and has had a thyroidectomy. Incidentally, you will find—and I know you have an expert on your committee in Dr. Rowland here who is a physician and I think it's a great asset to the committee and the House to have you here, Roy Rowland—you will find a higher than expected percentage of atomic veterans have thyroid cancer or other radiogenic illnesses.

He and his wife had nine children. All but one appeared perfectly normal at birth. One son, Steven, was born with one knee joined to his torso and without a hip or a thighbone. Let me read about the other eight children, who appeared to be perfectly normal at birth. The parents have no history of genetic disorders of any kind in their families.

Robert Jr., was born with a lung deformity—these are things they found out later. They didn't know at birth that he had a lung deformity. He was born with a lung deformity which has almost killed him twice through hemorrhaging.

Dianna was born with skull irregularities which bring on headaches severe enough at times to drive her to hospital emergency rooms for relief.

Victoria was born with abdominal and heart deformities.

Patricia had an 8-pound nonmalignant tumor removed 13 years ago.

William was born with small cyst-like bumps all over his body just beneath the skin.

Michael has an irregular heartbeat and is developing the same sort of bumps as William.

Jeffrey finds an extra bone growing in his right leg.

Janet suffers from a serious breathing problem.

All this tradegy in one family. After examining all possible sources of relief for this family and finding them inadequate, what I did in the last session and again in the this session of Congress was to introduce a bill that said, "Where there has been this exposure, and where you have reason to believe that the problem—for example, the problem of thyroid cancer—when you have such a high incidence among these people who are exposed, the Federal Government ought to recognize these as service-connected problems."

I also hope the committee will direct the VA to study several sample groups of veterans who were involved in those tests or perhaps suggest that the Centers for Disease Control down in Atlanta study it. Better still would be a completely independent study, headed, for instance, by a major university.

The second thing I ask is that where there is reason to believe that the problems children have has been caused by the parents' exposure while they served in the Armed Forces of this country, that we recognize that as a responsibility of this Government.

Right now Bob Farmer feels the VA doesn't care about him. He last heard from the VA about a year ago. I think that ought to change.

That's basically my message, Mr. Chairman. I really think that if every one of my colleagues in Congress could visit with Bob Farmer, there is no question we would be doing something.

[The prepared statement of Congressman Simon appears on p. 67.]

Mr. MONTGOMERY. Thank you, Mr. Simon. Just for the record, since I don't have your official statement in front of me, I didn't quite get clear where Farmer has had this exposure of radiation or when he had it.

Mr. SIMON. This was 37 years ago, which would have been 1946. He was 19 and it was in the Marshall Islands at Bikini. He was there for two tests.

Mr. MONTGOMERY. OK.

Mr. SIMON. He was just doing his duty and he is a fine solid citizen today, but he feels as though his Government hasn't treated him properly.

Mr. MONTGOMERY. One other question, Mr. Simon. Has he applied for service-connected disabilities and has he been turned down? Do you know?

Mr. SIMON. That is my understanding. Not only for him but for others in his situation.

Mr. MONTGOMERY. OK.

Mr. Sundquist?

Mr. SUNDQUIST. Thank you, Mr. Chairman. I thank our distinguished colleague for being here this morning and bringing this to our attention.

Mr. Simon, what is your bill number?

Mr. SIMON. It is H.R. 1914, the year World War I started, if that helps you.

Mr. SUNDQUIST. That won't be hard to remember, will it?

Do you have any idea, Mr. Simon, how many were involved in those tests at Bikini? I can remember when they occurred but I didn't know what the magnitude of the problem was.

Mr. SIMON. Well, it's not simply at Bikini. There are number of these tests, but the total of the national group of these veterans that were exposed is about 250,000.

Now of that number there are many of them who have since died. You also have the majority who, for one reason or another, don't seem to be susceptible. So your liability factor starts narrowing appreciably.

But for that small number who have been hit, it just seems to me that we ought to be doing more than we are doing.

Mr. SUNDQUIST. I agree with you.

Thank you, Mr. Chairman.

Mr. MONTGOMERY. Thank you, sir.

Dr. Rowland?

Dr. ROWLAND. I have no questions, Mr. Chairman.

Mr. MONTGOMERY. If Mr. Edgar doesn't mind, since he is not a member of the subcommittee, I would like to recognize Lane Evans, a member of the subcommittee.

Mr. EVANS. Congressman, I want to thank you for introducing this legislation. I believe it grows out of a problem that a constituent has in your district and it's a problem that several people in my district have come forward with and advised me of. I will be supporting H.R. 1914.

Mr. SIMON. I thank you. You are fortunate, Mr. Chairman, to have a good Illinoisan on this subcommittee here.

Mr. MONTGOMERY. I certainly agree with you. We don't come to order around here that Lane Evans is not right here. This is the first time he has been late, as I recall.

Mr. SIMON. He thought he would miss my testimony.

Mr. MONTGOMERY. Mr. Edgar, do you have any comments?

Mr. **Edgar**. Paul, it's a great pleasure to hear you this morning and to have you focus attention on compensation for atomic veterans who have been exposed.

As you indicated, between 1945 and 1962, there were over 235 tests that exposed upwards to 250,000 American service personnel to exposure and to date there have only been 25 persons who have received compensation from the VA for related diseases that have, in fact, been caused by their exposure to radiation and their exposure to the testing itself.

I think today's hearings will give us an opportunity to analyze in a way and measure the response of the United States to that exposure. Your specific illustration is very helpful.

You have the bill in to compensate persons and to provide care for those who have been exposed. I have a bill in, House Joint Resolution 210, which would establish July 16, 1983, as National Atomic Veterans Day. That particular date is the 38th anniversary of Trinity, which was the first explosion and it's a day set aside to recognize this problem. Hopefully, in the recognition and in the analysis and in the study and in the testimony that is received today, we can heighten the awareness of members of this committee and the rest of Congress to the specific need.

Hopefully, we can address the problem that you illustrated. Those families who have been devastated by the exposure were simply doing their duty to this Nation.

I commend you for your legislation and commend you for coming today.

Mr. **Simon**. I thank you and I support your important legislative effort for greater recognition of this problem. I hope, however, that we can do more than simply—and I know you share this feeling—provide the recognition.

Let me just add one other thing, Mr. Chairman: It becomes difficult to prove that this is related to the tests, but when you have incidences of thyroid cancer that are five or six times as great as among the general veterans population, then it seems to me that there is reason to make an assumption.

Again, I would defer to Dr. Rowland on this, but obviously, if a veteran has a broken leg or something like that, you don't provide a service-connected compensation. But when someone shows up who has been involved in these tests with thyroid cancer, then it seems to me the obligation becomes fairly clear.

Mr. **Montgomery**. Dr. Rowland.

Dr. **Rowland**. I do wish to make a statement, Mr. Chairman.[1]

I quite agree with you that the evidence becomes almost overwhelming, even though it's not scientific, that something is amiss when this incidence of thyroid disease does show up.

As I mentioned yesterday, we have known for many, many years that the reticulo endothelial system is very susceptible to radiation and leukemia, sarcomas, lymphomas, things of this nature that come about because of exposure to radiation. While the thyroid is not part of the reticulo endothelial system, the tissue is very similar in the thyroid and the lymph glands.

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[1] The prepared statement of Dr. Rowland appears on p. 74.

I want to commend you for the testimony that you have brought here this morning. I think that this type of testimony will cause us to have to take a much harder look than we have in the past at what has been taking place with these veterans that have been exposed to this ionizing radiation.

Thank you very much for being here this morning.

Mr. MONTGOMERY. Mr. Daschle.

Mr. DASCHLE. Thank you, Mr. Chairman.

Just briefly, I commend our colleague, Mr. Simon, for an excellent statement. Yesterday he illuminated on his reasons why he has become involved in this issue and it's similar to the reasons many of us get involved with some of these particular problems that we are facing.

He talked about a constituent of his that certainly has some very serious medical problems that most likely can be traced to the exposure that they had to radiation.

So it's that kind of a commitment that comes in talking to these people and whether we talk about medical evidence or whether we talk about legislative support, when we boil it all down, if comes to the very essence of why we are here and that is to assist those people and to follow through with the commitments made by this Government to its veterans.

I think the legislation that Paul has introduced very directly comes to that kind of assistance and I am a strong supporter of it. I just hope that this committee and this Congress can soon take up this legislation so these veterans who have waited so long will wait no more. I thank you for coming this morning.

Mr. SIMON. I thank you, and I thank you, Mr. Chairman, and all the members of your subcommittee.

Mr. MONTGOMERY. Well, thank you, Paul, for this very fine and constructive testimony and certainly the committee will take some action. We'll look at what you've said and what the other witnesses this morning have said, and that's the bottom line for having the hearing this morning, because of evidence and these problems that have developed in this field. Thank you for being our leadoff witness.

Mr. SIMON. Thank you very much.

Mr. MONTGOMERY. Our next witness will be Lt. Gen. Harry A. Griffith, Director of the Defense Nuclear Agency, and we'll let him introduce those gentlemen with him.

I might say, General Griffith, welcome to this committee. We've known each other over the years when you were in charge of the Mobile District, which covered the Pearl River in Mississippi.

General GRIFFITH. Yes, sir, Mr. Chairman. From what I hear on the radio I'm just as happy I'm not down there this morning.

STATEMENT OF LT. GEN. HARRY A. GRIFFITH, U.S. ARMY, DIRECTOR, DEFENSE NUCLEAR AGENCY, ACCOMPANIED BY ROBERT L. BRITTIGAN, GENERAL COUNSEL, AND DR. DAVID AUTON, CHIEF, HUMAN RESPONSE DIVISION

General GRIFFITH. Well, thank you very much, sir, for your generous introduction. I'm pleased to have this opportunity to appear before you today to explain our nuclear test personnel review program. I'm accompanied by Dr. David Auton, my scientific adviser, on my left, and Mr. Robert Brittigan, our general counsel, on my right.

The nuclear test personnel review program was established in 1978 and is designed to assist veterans and their families by making available information concerning their participation in atmospheric nuclear testing. Under this program we have distributed 33 personnel-oriented histories to more than 700 locations throughout the United States and made them available to the public through the National Technical Information Service.

Copies of these reports have been provided to your staff, sir.

When the remaining seven documents are published later this year, the library will contain a comprehensive history of military participation in each nuclear test. We have identified by name more than 206,000 of the estimated 220,000 Department of Defense participants and have recovered information on more than 139,000 film badge readings.

We are calculating radiation exposures both to correlate with badge readings and to substitute for dosimetry that is not available.

We maintain a toll-free information number through which interested persons can contact us to obtain information. More than 49,000 contacts have been established through the call-in program. We have identified more than 1,100 persons who received radiation doses between 5 and 25 rem, and another 39 who received in excess of 25 rem. We have notified those persons for whom we have current addresses of their dose and that they are entitled to a free medical examination, through the Veterans' Administration.

Finally, we have declassified more than 800 documents relating to atmospheric nuclear tests, placed them in the Library of Congress, and made them available to the public through the National Technical Information Service.

All of these program tasks are continuing. Now, the extensive research and analysis that we have conducted have disclosed that the overwhelming majority of nuclear test participants received no radiation at all or only a small fraction of the five rem that is the current Federal guideline for annual exposure of radiation workers. In fact, the average exposure was about one-half rem.

We are confident that this conclusion will not be changed by subsequent research because we have given first priority to analyzing those tests involving the greatest potential for internal and external exposure.

With respect to Hiroshima and Nagasaki veterans, we performed a worst-case analysis which demonstrated that the dose to any of these occupation forces could not have exceeded 1 rem.

Now, I understand that the committee has a particular interest in our dose reconstruction efforts. When film badge data is missing or is inadequate, we determine the dose by comparing specific activities of each unit with the documented radiation environment. We also examine potential exposure which would not have been recorded on film badges.

Where there was a possibility for a neutron exposure, we reconstruct those doses. We also consider the potential for internal exposure due to inhaled or ingested radiation.

The details of these calculations are explained in my prepared statement and attachments.

Now, an important feature of the dose reconstruction methodology is treatment of uncertainties. With respect to external doses, we perform an uncertainty analysis that considers the accuracy and the reliability of the data used in determining each of the relevant variables. The overall uncertainty represented by upper and lower limits accompany the calculated external dose.

Internal dose calculations are usually dominated by the uncertainty in how much radioactive dust was in the air. Consequently, we give the benefit of the doubt to the veteran and use a high-sided figure in the calculations. This results in an expression of an upper limit of potential internal exposure.

We have compared calculated external doses to documented film badge readings and found the correlation to be excellent. Our methodology has received extensive peer review. We have published the methodology in the Federal Register and carefully reviewed the comments received. Accordingly, we are confident that the dose reconstruction methodology used in the nuclear test personnel review program is sound.

Nevertheless, we have asked the National Academy of Sciences to conduct a formal review of the overall methodology, as published in the Federal Register.

In conclusion, we are confident that we have a successful nuclear test personnel review program that will determine all relevant information concerning the participation of military personnel in nuclear operations. We shall continue to devote the necessary resources on a priority basis to complete the program and we will continue to provide all possible assistance to the veterans, to the Veterans' Administration, and other interested agencies and organizations.

Sir, that concludes my statement and I would be pleased to answer any questions you might have.

[The prepared statement of Genral Griffith appears on p. 75.]

Mr. MONTGOMERY. Thank you, General. Thank you for staying within your time on such a complicated subject and for your comprehensive testimony this morning.

As I understood your testimony, none of those who participated in these radiation tests years ago showed more exposure than 5 rem?

General GRIFFITH. Well, we had 1,100, sir, that had between 5 and 25 rem. Five rem is what anybody who works in the radiation business, like X-ray technologists or anybody that works around nuclear power plants, may receive in any one year. This is a standard that's set by health authorities for safety.

And what we're saying is that of the 220,000 veterans who were exposed, that only 1,100 got more than 5 rem, and only 39 got more than 25 rem.

Mr. MONTGOMERY. Well, what is the danger area that would cause human body breakdowns of the different organs?

General GRIFFITH. Well, that varies, depending on the situation. I know that in medical treatment they allow very high concentrations. But I think this is a very complicated question, sir, that perhaps one who is a radiologist or a doctor would be more competent to answer.

Mr. **Montgomery**. How about Dr. Auton? Could you?

Dr. **Auton**. Sir, as General Griffith has stated, this is a fairly complicated problem, but I think competent authority and scientific opinion varies on this issue. I believe that later on this morning you will be hearing from some folks that are better able to address this issue than possibly I am, but as General Griffith has stated, the current guidelines are 5 rem per year. We believe that these guidelines represent reasonable risks for the kinds of benefits that are given under those circumstances.

We have no evidence, from animal studies, or from human data, that low doses of radiation cause cancer. We do have it from animal studies and, of course, we have the high dose data from Hiroshima and Nagasaki.

Mr. **Montgomery**. Who are those on Hiroshima and Nagasaki? Were those Americans in the aircraft or did you run tests on the ground of the Japanese?

Dr. **Auton**. No, sir. There have been studies for several years of the Japanese and, actually, the Atomic Bomb Casualty Commission started studying the Japanese folks right after the bombs and they got in there about October or November timeframe. And we've been studying the Japanese ever since. That study is still ongoing.

There were some troops, occupation troops, in both Hiroshima and Nagasaki, and we have taken a look at the doses for those troops and we see that the upper limit for the dose, as far as we can tell, is like 1 rem. I must emphasize that these troops got in some several days to months after the bombings, and so therefore they weren't exposed directly to the bombs themselves, but to residual radiation.

Mr. **Montgomery**. General Griffith, correct me if I state this wrong, but what you're basically saying is of the well over 200,000 Americans that were involved in the testing, that as far as you can tell the rems were not that high and did not cause that much exposure in these Americans?

General **Griffith**. That's true, sir, and perhaps if I could elaborate on that answer just a bit by giving you some statistics which might illustrate the terribly complex and difficult nature of this problem. One-third of all the people in this country are going to get cancer. One-sixth of the people who die in this country die of cancer. So, if you take the 220,000 who were exposed and you take a sixth of that, you're talking on the order of 37,000 of those veterans are expected to die of cancer. This is a National Cancer Institute statistics.

Now, the statistics of the business are that if you take the half-rem average dose and apply it to that 220,000 person group, you get 110,000 person rem. That's simply 220,000 times a half, which is 110,000 person rem. Statistically it's recognized that 10,000 person rem will result in a cancer death. Now, this is just a statistical term. It could be 10,000 people getting 1 rem. It could be one person getting 10,000 rem. But 10,000 person rem will result in a cancer death.

So, that means of 110,000 person rem divided by 10,000, 11 of those people, statistically, would die because of the radiation exposure; 37,000 of them are going to die of naturally occuring cancer, according to statistics. If you divide 11 into 37,000 that means about 1 in 3,400 will die, additionally, as a result of the radiation.

The problem is that a cancer due to natural causes and a cancer caused by this kind of radiation are clinically indistinguishable, and there is no way to prove that the individual who is 1 of the 11 is 1 of the 37,000 or is not 1 of the 37,000, and as Dr. Auton said, I think the scientific community, both nationally and internationally, agree that low dose, and when we talk a half-a-rem average, that's low dose, because we set our own annual standards at 5 rem. Low dose is tantamount to low risk. And yet you can't say that it is zero; but it's low. And therein lies the problem. It's just a terribly complex and difficult problem.

Mr. MONTGOMERY. Well, thank you. My time is up but you've certainly created some more questions in my mind. Mr. Sundquist?

Mr. SUNDQUIST. Thank you, Mr. Chairman.

How do you measure for rem?

General GRIFFITH. How do you measure rem?

Mr. SUNDQUIST. Yes.

General GRIFFITH. With instrumentation.

Dr. AUTON. Dosimetry data.

Mr. SUNDQUIST. You mean it stays there with the body? In other words, someone, as Mr. Simon had explained earlier, who was at one of the atolls and was exposed, can you measure the rem in that person and find out now how serious his exposure was?

General GRIFFITH. Well, dosimetry measures the prompt gamma radiation, but there are reconstructions that we can do when we suspect that there was either neutron or some ingested. But, Dave, you might want to elaborate.

Dr. AUTON. Yes, sir, if I could.

In general what we're talking about with the nuclear test participants was, we feel, prompt doses; that is, the doses that they got either from the direct bomb blast itself, which were usually very small, or from maneuvering in the residual fallout fields.

These are prompt doses to the body.

The effects may stay with the body for a long time, although the doses can't be said to stay with the body, because they are just gotten sort of immediately and that's it.

Mr. SUNDQUIST. So you're reconstructing?

Dr. AUTON. Yes. We're reconstructing.

Mr. SUNDQUIST. You're reconstructing. You're not measuring it?

Dr. AUTON. We're not measuring. We're trying to predict what happened and reconstruct those doses to those folks.

Mr. SUNDQUIST. If I could, then when you're reconstructing, how do you—I can understand, you know, what the size of the blast was and you can reconstruct that way, but how do you take into account, then, those individuals who, in fact, did wash down ships, those who stayed in that area longer, who perhaps swam, who ate the food in that area?

How do you reconstruct that?

Dr. AUTON. Sir, I'd like to give a detailed answer to that question for the record.

[The information follows:]

Dose reconstructions have been accomplished for many specific activities, to include all relevant movements and exposure situations. Every dose reconstruction begins with a detailed description of the precise day-by-day, and hour-by-hour if necessary, activities of each unit being analyzed. The concurrent radiation environment is also characterized and superposed with troop activities in order that the dose can be determined for each period of each activity. Internal dose is determined similarly, if the activities in the radiation environment could lead to inhalation or ingestion of radioactive materials. Personnel exposed to additional radiation in the line of duty (e.g. monitoring and decontamination personnel) were preferentially provided individual film badging; thus dose reconstruction for such personnel is less commonly at issue.

Dr. AUTON. But basically what we do is we make some assumptions about how much of the radioactive material is in the air, how much they breath, how much they take into the body, how much is retained by the body over a long period of time, and how much dose they get from that.

Mr. SUNDQUIST. Have you taken into account then, Doctor, the fact that early on in this testing we were not as sophisticated, we were not as aware, of the severe problems that occurred and the fact that we perhaps did not have the protection of our individuals during that period?

Dr. AUTON. Sir, we've looked at all of those issues, yes.

Mr. SUNDQUIST. You have taken that into account?

Dr. AUTON. Yes, we have.

Mr. SUNDQUIST. And have you separated out, then, in that 1,100, those individuals from the earlier tests as opposed to the later tests?

Dr. AUTON. We know the names of those individuals.

Mr. SUNDQUIST. That's not my question.

Dr. AUTON. Absolutely.

Mr. SUNDQUIST. My question is do you know the numbers in the early tests and how much, potentially, more serious those were than those later?

Dr. AUTON. Yes, sir; we can give you those statistics.

Mr. SUNDQUIST. I'm interested to know if you have them.

Dr. AUTON. Yes; we do.

Mr. SUNDQUIST. Then you said earlier, General, that with the high incidence of cancer in the general population, it's difficult to judge whether or not this is normal or if it came from the test. Have you had any data that comes as a result of those tests that occurred in 1946 to see if those individuals have incurred more cancer or a higher rate of cancer than perhaps the normal population during that same period?

General GRIFFITH. Well, as a matter of fact, the National Academy of Sciences is doing a study right now with 50,000 mortalities of the participants. They picked the 50,000 and their report is due at the end of this year. But overall, we have found that there has been less mortality due to cancer among all the veteran samples than there has been in the population at large.

Mr. SUNDQUIST. I'm asking specifically about those that were exposed early on, before we had sophisticated measuring equipment and before we perhaps had the protection we did later on in the blast testing.

I'm talking about the folks that Mr. Simon was talking about earlier, where they were on an island and they were sent in to wash the ships afterward and stayed there and swam and ate. Have we separated those groups out scientifically and compared those to the general population?

Dr. AUTON. Sir, if I could answer that, part of the National Academy study is what's called the series Greenhouse. Greenhouse was one of the earlier tests. It was one of the first test series on the islands that you're talking about. So, the statistics and the answer to that question will come out of the National Academy study.

Mr. SUNDQUIST. What about your answer?

Dr. AUTON. Sir?

Mr. SUNDQUIST. What's your reaction? I'm not concerned about the National Academy study. I'm interested in your testimony today.

Dr. AUTON. OK.

Sir, I believe as you go back and look at the records, you'll find that clearly in the nuclear industry and also in the nuclear test series, we learned more as time progressed. I don't think, though, that you'll find, that the protective measures that we took were any different early on than they were later.

Protective measures basically consist of keeping people out of the radiation areas and we've done that throughout.

Mr. SUNDQUIST. I find that a ludicrous statement, Dr. Auton, based on what I'm hearing. I really can't believe that, that we took all the measurements, all the safeguards, early on that we did later in testing.

Dr. AUTON. Sir, as I said, the basic safeguard consists of keeping the folks out of the radiation areas, and we tried to do that, both early on and later on.

Mr. SUNDQUIST. Mr. Chairman, my time is up but in my opinion there have been more questions raised than there have been answers.

Mr. MONTGOMERY. Thank you, Mr. Sundquist.

Dr. Rowland?

Dr. ROWLAND. Thank you, Mr. Chairman.

You mentioned a few moments ago that a third of all the people in the country will eventually die with cancer.

General GRIFFITH. Excuse me, sir. I believe I said a sixth. Sorry. These are National Cancer Institute figures. A third get cancer. A sixth are supposed to die.

Dr. ROWLAND. That's right. OK. Well, a third get cancer.

General GRIFFITH. Sorry.

Dr. ROWLAND. I think that we are particularly concerned here with a certain type of cancer, not cancer in general. Could you break it down a little more, particularly with reference to cancer that involves reticulo endothelial systems, which we seem to be more concerned with, exposure to ionizing radiation?

General GRIFFITH. Sir, if I may, that's a fairly technical question, the answer to which I'd like to provide for the record. I'm not prepared to answer that question at this time.

Dr. ROWLAND. Dr. Auton?

Dr. AUTON. Yes, sir?

Dr. ROWLAND. Do you have any idea about that?

Dr. AUTON. No, sir. I'd like to take that for the record as well.

Dr. ROWLAND. All right.

[The information follows:]

A radiogenic cancer is one in which radiation can serve as the initiator and/or promotor of the cancer. The most important cancer of this nature relative to the reticuloendothelial system is leukemia. In the United States the overall annual incidence rate for leukemia is about 4.3 cases per 100,000 people. For a population of troops who were participants at the test some 26 years ago this would work out to be about 112 cases per 100,000 people. For very high doses (the mid-lethal range of 400 rem) radiation can initiate or promote leukemia in up to about 1 percent of the population. At doses below 50 rem the data is inconclusive and leads to debate relative to linear, linear quadratic and quadratic response curves. At doses of 1 rem or less there is evidence that the radiation is not harmful. Studies at Los Alamos on mice and World Health Organization studies of high background areas of the world, especially Kerala, India, for instance, support this finding.

In the mortality study of the nuclear test participants done by the National Academy of Sciences, the cancer deaths of all kinds is the same as or less than that of the U.S. population as a whole except for the SMOKY participants. This statement is also true for leukemia. In the SMOKY sample neither the Centers for Disease Control nor the National Academy of Sciences has ascribed the apparent excess leukemia rate to radiation.

Dr. ROWLAND. Very well.

May I just make the point, Mr. Chairman, that when we talk about cancer in general, that we are more concerned here with this particular type of cancer, and that it will certainly be interesting to learn about that particular aspect.

Let me ask about the film badges that you use to determine the number of rems that a person is exposed to over a period of time. Does this take into consideration, for example, radiation that might be ingested or in contaminated food or that might be inhaled in the respiratory tract? Does the film badge measure that in any manner?

General GRIFFITH. No, sir. It only measures prompt gamma. We obtain other doses through reconstruction.

Dr. ROWLAND. All right. So, we really don't know about the exposure from the standpoint of food ingested or inhalation of dust that might be contaminated? Is that correct?

Dr. AUTON. Sir, we can reconstruct those doses and, as I said, we have. There are also ways to measure the doses internally, and some of that has been done as well, particularly among the high-dose people that were over 25 rem.

There have been—well, I think Dr. Caldwell could address part of this—but I think there have been some tissue studies as well.

Dr. ROWLAND. Could you explain a little bit more about that to me? What is the technique of that, just exactly how you go about doing that?

Dr. AUTON. Which one, sir?

Dr. ROWLAND. Well, the tissue studies.

Dr. AUTON. OK. What you have to do, of course, is take biopsies and then measure the radiation that's coming out of that.

Dr. ROWLAND. But you usually take the biopsies only if there's some symptom that causes you to have to do that. I mean, you don't take biopsies on people who are apparently normal?

Dr. AUTON. No, sir.

Dr. ROWLAND. So, we really don't have any way to make a comparison, do we?

Dr. Auton. Not on the general population of test participants, from that point of view.

Dr. Rowland. OK. Thank you, Mr. Chairman. Thank you.

Mr. Montgomery. Thank you. The Chair will recognize members on the subcommittee that came in. Mr. Evans?

Mr. Evans. At the recent Senate hearing the VA announced publication of new guidelines under Public Law 97-72 which will assure health care for all atomic veterans. Would your agency be willing to distribute to each of the 49,000 atomic veterans that you've had contact with a copy of the new VA circular pointing out that this new health care is available at this time?

General Griffith. Yes, sir, we would.

Mr. Evans. Can you tell us when you would be doing this?

General Griffith. Do you know when it's coming out?

Mr. Brittigan. We'd be willing to do it and we could do that, probably within 30 days.

General Griffith. I would estimate that we would be able to do that within 30 days.

Mr. Evans. All right.

You suggested in your April testimony that all declassified documents relating to atmospheric testing of nuclear weapons would be available to the National Technical Information Service. If this is true, then why is it that information that was obtained by the National Association of Atomic Veterans, from Dr. Stafford Warren's collection at the UCLA library, all of which was declassified in 1964, is not on your list and is not available to the veterans or the public in general?

General Griffith. We became aware of that information about 2 months ago and we do have a group of researchers that are examining it and we will certainly incorporate that information and use it as appropriate.

Mr. Evans. Are you going to make it available through this information service?

General Griffith. It's public information so it would be available.

Mr. Evans. Are you going to place it on your list, your bibliography?

General Griffith. We'd certainly use it, yes.

Mr. Evans. You have consistently stated that radiation exposures were extremely low and indicated that other studies might be counterproductive. Are you familiar with an April 1980 Washington Post article which indicates that radiation levels were actually 10 times greater than the radiation safety standards for the general population? [1]

General Griffith. I'm not sure about the article to which you make reference.

Mr. Evans. I will submit it to you.

General Griffith. Was that the VanBranden article?

Mr. Evans. I don't have a copy with me.

General Griffith. We had one individual who asserted that when the tests were going on that two sets of records were kept—he received a fair amount of publicity and when we checked it out we found out that he was totally in error. In fact, he wasn't where he said he was and if he had been where he said he was he wouldn't have seen what he said he saw.

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[1] See p. 472.

So, we're quite confident with the accuracy of our findings.

Mr. EVANS. I have nothing further, Mr. Chairman.

Mr. MONTGOMERY. Mrs. Johnson?

Mrs. JOHNSON. Thank you very much, Mr. Chairman.

I have one question, General Griffith. What percentage of the tests were fission devices as opposed to fusion devices? Is there any difference in the kind of radiation that was emitted and how would you relate this to the human tissue effects?

General GRIFFITH. Mrs. Johnson, if I may, I'd like to provide the answer to that for the record.

Mrs. JOHNSON. We would be interested in that very much, yes.

General GRIFFITH. Yes, ma'am.

[The information follows:]

Discuss the differences in health effects and radiation exposure between fission and fusion devices. How many tests were fission and how many fusion?

There is little difference in health effects from exposure to fission vs. fusion devices. From an immediate effect standpoint, the much larger yield of fusion devices necessitates greater stand-off distances and more protection from the larger-range thermal (heat) radiation. For this reason, there was no exposure to initial nuclear radiation from the fusion weapons tested in the Pacific. Because fusion weapons always have considerable fission yield as well, the fission products, plus neutron-activated environmental materials, comprise the bulk of the radioactive fallout from all nuclear tests. Therefore, if two devices of the same yield are detonated under similar circumstances, but one is 50 percent fusion, the residual radiation is reduced by about the same proportion. The relationship of residual effects to health effects is completely dependent on the particular circumstances of individual exposure.

As for the number of tests of fission and fusion devices, all nine oceanic tests before 1952, and all 101 continental atmospheric tests, were fission. Most oceanic tests thereafter involved fusion to some degree.

Mrs. JOHNSON. My earlier questions were addressed by Mr. Evans. Thanks very much.

Mr. MONTGOMERY. Thank you.

Mr. Staggers, a member of the subcommittee?

Mr. STAGGERS. Thank you, Mr. Chairman.

I've listened to some of the testimony and there are a couple of things that bother me. These film badges, how accurate are they and how reliable? I heard some allusion to that they were the most scientific means. Could you tell me exactly what we're doing here? How reliable are these? Is there a question in your mind?

General GRIFFITH. Sir, at lower levels, on the order of 10 to 20 millirem, they don't measure very well. At higher levels, where we're concerned for the radiation exposure, they measure fairly well. What I'm saying, is that it's like the speedometer of your car where at 2 miles an hour it's not a very accurate instrument. At 30 miles an hour it is a fairly accurate instrument.

The film badges act the same way, basically.

Mr. STAGGERS. You're comparing the film badges to my——

General GRIFFITH. I'm comparing the accuracy of the film badges to the speedometer on your car.

Mr. STAGGERS. From my knowledge of a speedometer of a car, that is not very reliable and not very accurate. There are a lot of things that can go into it, tire size, different things that could go into it. That is a problem I have.

Another thing would be it appears that we're basing it on something that may be unreliable, and also this reconstruction as opposed to resources. Is that basically the direction that we're heading, as opposed to looking at the veterans? If they do have a problem with cancer, more so than the populace as a whole, there seems to be a problem, as opposed to just saying, "Well, we reconstructed it 10 years later," or whatever, "and we're basing it on this film badge," that isn't that reliable or that accurate. Is that what we're doing? Is that the direction we're moving in?

General **GRIFFITH**. Well, I think if we were doing it today we would do the same thing. We use film badges in anything that has to do with radiation.

Mr. **STAGGERS**. What about the results? Have we actually looked at the results of how many veterans have been exposed to this are suffering from some abnormal-type problems, you know, chromosome breakdown, cancer, or whatever? Are we going in that direction also or are we just reconstructing it and taking film badges and saying you don't have a problem?

General **GRIFFITH**. Well, the first thing, as I have mentioned in my testimony, we have correlated dose reconstruction with film badge readings and we found the correlation to be excellent.

As far as I know, the film badges that are used today are pretty much similar to the film badges that were used then.

Now, as to the detailed examination of the veterans, we have tried to contact them and make it known to them that they are entitled to physical examinations, especially the ones who got between 5 and 25 rem, and over 25 rem.

Mr. **STAGGERS**. Are you saying the ones that have not been exposed to that many rems do not have a problem? Is that what you're talking about?

General **GRIFFITH**. I'm not saying that any of them do not have a problem. I'm saying that we are doing everything that we can to try to help them identify their problem and give it as close an examination as we can, and we are making available to them all the facts and technical information.

Mr. **STAGGERS**. When they ran these tests, did they wear protective equipment? I mean the DNA officials. Do they wear protective equipment?

Dr. **AUTON**. When folks went into high dose rate areas they wore protective equipment. Since, by and large, the maneuver troops didn't go into those kinds of areas, we didn't have protective equipment on those people. But we did on the radiation safety monitors, and also the experimental people who went in early and got experimental equipment out right after the bomb blasts.

Mr. **STAGGERS**. OK. When you're reconstructing, you do not wear protective equipment unless it's a high-dosage area?

Dr. **AUTON**. When we're reconstructing we assume they didn't wear protective equipment; that's right.

Mr. **STAGGERS**. The officials don't wear that? The DNA officials?

Mr. **EDGAR**. Will the gentleman yield?

Mr. **STAGGERS**. I'll yield.

Mr. **EDGAR**. I think your question is a good one but I think that we haven't heard yet whether or not the reconstruction involves physical reconstruction or paperwork reconstruction. Are you actually reconstructing like dosages or are you doing it by paper? I think that's where the difference is.

Dr. **Auton**. What we're doing is an analysis on paper of what folks might have gotten if they—knowing how they moved in the radiation fields and knowing how long they stayed there. We can reconstruct how much dose they got.

Mr. **Edgar**. OK. Thank you.

Mr. **Staggers**. Thank you.

Mr. **Montgomery**. Mr. Edgar?

Mr. **Edgar**. Thank you, Mr. Chairman.

I have a number of questions. Let me first clear up something. The film badges only detected gamma radiation. Isn't that correct?

General **Griffith**. That's true.

Mr. **Edgar**. We have documents, some of which will be released a little later, that indicate that there was great uncertainty, particularly in the early tests, of the other detection instruments in terms of their quality and reliability, and indications from very official sources on the Crossroads tests and some of the other testing programs that indicated that the early instrumentation of measurements of all of the different kinds of radiation were not very accurate.

Would you agree with that kind of analysis?

Dr. **Auton**. Sir, for the earlier tests, I think what we need to do is probably, as General Griffith indicated, take a look at the documentation, since we just became aware of it. I'm referring to Crossroads, of course.

For all tests, we were using instrumentation which was developed by the health physics folks at Oak Ridge and was widely used at that time for health physics work.

Mr. **Edgar**. Dr. Auton, in making that statement you've just reversed the comment you made earlier, in a sense, to my colleague, who was asking you whether or not protections later on were better suited than those in the earlier tests, and if the detection devices changed, clearly the safety factor changed as those detection devices improved. Wouldn't that be correct?

Dr. **Auton**. Well, the uncertainty may have changed as the detection devices improved, though.

Mr. **Edgar**. Let me ask another question.

General **Griffith**. Sir, if I could, may I add a comment?

Mr. **Edgar**. Yes.

General **Griffith**. Mr. Chairman, what I would like to do is to provide for the record the best possible set of information that we can to you on two things which I think are related but need to be kept distinct. First of all, I think one thing we're talking about are the standards that were set as the troops were taken through these training exercises, and what the criteria were.

Then, second, the instrumentation that was used in the measurement to make sure that the standards were met and that we gathered the best data we can. I'd like to just give you a rundown on that.

Mr. **Montgomery**. The Chair would like to have that.

[The information follows:]

Why rely on inaccurate film badge data and uncertain reconstructions when we can look at the health effects being experienced by veterans?

The film badge was and still is the most reliable instrument for measuring external gamma radiation dose. Where film badge data are not available, or there is reason to believe that the badge does not represent the total exposure (such as in the case of damaged badges or exposure to neutrons), a dose reconstruction is performed. Dose reconstructions use all relevant data to reduce uncertainties. The accuracy of reconstructions has been demonstrated consistently by comparison with available film badge data; thus, we have very high confidence in the reliability of the resulting dose determination. On the other hand, health effects assumed to be associated with low levels of radiation exposure are derived from statistical analysis; hence, when an individual develops a radiogenic illness, there is no way to ascribe the problem to a particular low-level exposure, regardless of the magnitude of the dose. A particular radiogenic effect can be due to a multitude of causes, such as carcinogens, smoking, radiation, or other natural (non-specific) causes. Even background radiation, 100–200 mrem per year, is higher than the dose accrued by the overwhelming majority of nuclear test participants. Finally, it has not been demonstrated that the health effects experienced overall by atomic veterans are any worse than the health effects experienced by similar groups.

What were the standards and what were the instrumentation capabilities over the years of atmospheric nuclear testing?

The radiation exposure standards have been basically the same for years, varying from a low of 3 rem (many operations) to a high of 6 rem (Desert Rock V and VI) for an operation. There were exceptions to this for special groups, such as cloud sampler crews and officer volunteer observers, who were permitted doses of 7.5–20 rem. Generally, whenever anyone entered a higher-than-normal risk area (e.g., scientific instrument recovery), he wore a film badge. Large groups who stayed together and who were in lower level radiation areas were sometimes badged representatively. Radiation monitors accompanied persons entering radiation areas and apprised them of the levels and allowable duration of stay. Guidance in gamma intensity limits was such that the overall dose limit was rarely approached.

Instruments have improved through the years, mostly in ruggedness, compactness, versatility, and power required. Early instruments, such as the Geiger-Muller counter, were accurate but cumbersome. Back-ups were often carried to replace those for which the batteries had run down. Today's transistorized instruments are highly reliable but hardly more accurate. This is because all instruments have always been calibrated to a known radiation source to provide consistent, accurate surveys of the radiation field.

Mr. MONTGOMERY. The Chair would like to point out too that the next two panels maybe will clear up some of the questions that are being asked right now pertaining to the dosages.

Mr. EDGAR. Mr. Chairman, I have additional questions which relate specifically to the Department of Defense.

Mr. MONTGOMERY. All right. Well, it's your time.

Mr. EDGAR. Thank you.

Mr. MONTGOMERY. I was just telling members that we do have these other witnesses.

Mr. EDGAR. Mr. Chairman, I'd like to ask unanimous consent to insert in the record a letter of September 4, 1981 that was sent by the General Counsel of the Department of Defense and the signature is William H. Taft IV, who is writing to you on the issue of an earlier bill, H.R. 3499, in the 97th Congress, to amend title 38, United States Code, and to extend some readjustment counseling. But it also provided for coverage of the atomic veterans in the health care area.

In a letter that was written to the chairman of this committee, Sonny Montgomery, dated September 4, some statements were made addressing the issue of whether or not the VA should care for atomic veterans. I'd like to have that inserted in the record, Mr. Chairman.

Mr. MONTGOMERY. Without objection, so ordered.[1]

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[1] See p. 258.

Mr. **Edgar**. Let me quote a very curious paragraph from this letter:

> We are concerned with the perceptions among both veterans and the public of what would result from the enactment of H.R. 3499, as passed by the Senate, that bill which eventually became law. Section 3 of the Senate-passed bill creates the unmistakable impression that exposure to low-level ionizing radiation is a significant health hazard when available scientific and medical evidence simply does not support that contention. This mistaken impression has the potential to be seriously damaging to every aspect of the Department of Defense's nuclear weapons and nuclear propulsion program. The legislation could adversely affect our relations with our European allies, impact upon the civilian nuclear power industry, and raise questions regarding the use of radioactive substances in medical-diagnosis and treatment.

Does the Department of Defense still believe that that is true, an analysis of the legislation which eventually became law?

General **Griffith**. I believe it's true. I think that the letter said it well. The scientific opinion is that low levels of radiation are low risk. I think that the 5 rem Federal standard has been a good one and I think that if we encourage the notion that exposures to half a rem or a rem is hazardous to the health, that it could reflect seriously in major ways in our civilian economy as well as in our military.

Mr. **Edgar**. Except your letter inferred that it will destroy the Western alliance and it will do damage to the future of the nuclear power industry and now that it has become law that we are enabling the VA to have medical analysis of these veterans has it, in fact, done the devastating damage that is suggested in this letter?

General **Griffith**. Well, to my knowledge, there has been no devastating damage yet and——

Mr. **Edgar**. Thank you. That's, I think, an important point.

General **Griffith** [continuing]. That I know of.

Mr. **Brittigan**. If I may, however after that letter was dispatched your chairman inserted some very helpful language in the bill with respect to causation; and in our view, that greatly alleviated the adverse impact of the bill.

Mr. **Edgar**. Helpful to whom?

Mr. **Brittigan**. Language that was helpful to avoid a misperception, the fact that providing treatment necessarily gave rise to any presumption as to causation. I don't recall the precise language, but it was to the effect that treatment was without regard to whether or not the exposure caused the disability.

Mr. **Edgar**. Thank you, Mr. Chairman.

I have two additional questions that I will save for the second round.

Mr. **Montgomery**. Mr. Daschle.

Mr. **Daschle**. Thank you, Mr. Chairman.

General Griffith, have you read the decontamination report that followed Operation Crossroads?

General **Griffith**. No, I haven't.

Mr. **Daschle**. You haven't read it. Have you read the correspondence that Col. Stafford L. Warren, who was the Chief of the Radiological Safety Section at Operation Crossroads had compiled after the tests?

General **Griffith**. No, I haven't seen that correspondence.

Mr. DASCHLE. Well, are you in charge of this operation? Wouldn't you think that this is something that anyone who would be in charge of a study as important as yours would—just a minute ago, you said that you have really done everything you could to point out what information is available to insure that we get all the right data. I am startled somewhat.

If you had read that, I think you would find that there was some tremendous conflicts in the testimony you have provided and the information in that decontamination report.

For example, reading an excerpt from the report that "They had predicted that the radioactive column from the explosion had to have risen more than 10,000 feet, and if it didn't rise that fast or that high, that the radiological conditions would be extremely serious." This is Stafford Warren's comment.

I thought, in reading the report, one of the most interesting things was that they found some of the ships so contaminated as a result of that that they didn't even try to decontaminate the vessels. They sunk those ships. There were 42,000 people on those ships, 200 ships, and some of them were sunk.

Now, how in your mind can you say that if we would think a ship to be so contaminated, that we would actually sink it rather than try to decontaminate it, that the men on those ships have no cause for concern?

General GRIFFITH. Well, I became aware of the Warren notes and memoranda this morning, as I mentioned earlier. Part of our effort now includes carefully examining that and you can be sure that his assertions will be carefully considered.

Mr. DASCHLE. How long have you been on this? When did you get this assignment?

General GRIFFITH. I have been the Director of the Defense Nuclear Agency since August of 1980, but as I said, I heard of the Warren business this morning.

Mr. DASCHLE. You have had no cause to look at the Warren correspondence or the decontamination report?

Dr. AUTON. If I could just elaborate a second, sir. The 42,000 people that you are referring to were not on the ships that you are referring to.

The 42,000 people were on support ships and troop ships. The ships you are referring to were target ships.

Mr. DASCHLE. But were they not on the nuclear test site—at or near the nuclear test site?

Dr. AUTON. Sir, the support ships were way outside the target area and the target ships that you are talking about, the ones that were so contaminated that they had to be sunk, had no troops on them at the time of the blast.

Mr. DASCHLE. The point I am making, it comes right from Colonel Warren's correspondence. He said that, "Men were sent into those ships and into the radioactive lagoon to measure radioactivity and to retrieve instruments. Within 3 days they were also sent into the highly radioactive ships to measure radiation and to retrieve equipment, instruments, and experimental animals." That is direct from the correspondence.

Then Colonel Warren goes on to say, "The tolerance limits were more than 5,000 times the allowable limit of 5 millirems per year set by the Nuclear Regulatory Commission." He also says that, "Film badge records often exceeded daily tolerance limits which can't be replicated in paper. The indifference of officers to radiological safety led them to keep men for long periods in high radiation areas, often in violation of radiological safety rules and guidelines. Radiation instruments often did not work."

Now this isn't my language. This is the language right from the report and from the chief of the Radiological Safety Section at this operation.

So we don't have to look and replicate this whole thing. We don't have to come up with new paper statistics. We have got all of the information we need right here.

How can you actually look at this, consider that and come up with the conclusion you have that only 1,100 got more than 5 rems, only 39 got in excess of 25 rems.

And then we get the director, General Griffith, coming before us and he says that he hasn't even read the study, he hasn't even looked at this correspondence and yet he is so convinced that this information is accurate.

Can you respond?

Dr. AUTON. As we said, we just became aware of that documentation.

I might add that this whole effort has been a tremendous detective effort to look for documentation all over the country. One simply cannot look at everyone's garage.

Now having said that——

Mr. DASCHLE. Oh, that's quite a statement. Although my time is out, I think you better clarify that.

The fact is that this was a classified document, declassified in 1975. It's been available to us now and it's not some pipedream that somebody came up with to consider what all of the scary and nightmarish ramifications.

Dr. AUTON. No, I didn't say——

Mr. DASCHLE. Actually, I am corrected. It was 1965 that it was declassified.

Dr. AUTON. I didn't imply that the documents were not declassified and that they were not in the public record. It just happens to have been in a repository that we didn't look at. We will certainly take a look at them and see whether they compare or just exactly how we can use them.

What I might add as well is that the folks who went into those lagoons and into the target ships, in general, had film badges with them. So we have film badge readings for those folks.

Mr. DASCHLE. I am glad you said, "in general," and I know my time is up.

Thank you, Mr. Chairman.

Mr. MONTGOMERY. Mr. Penny.

Mr. PENNY. I have no questions.

Mr. MONTGOMERY. The Chair would be glad to recognize any Member for another 5 minutes, but we would hope that we could speed this thing along because I know a number of members have to leave at 10, and I think these next witnesses will be important to the hearing, as these witnesses have. But the Chair would be glad to recognize the gentleman.

Mr. **Edgar**. Thank you, Mr. Chairman.

On page 1 of your written testimony, you state that the DNA is developing a comprehensive history of military participation in each nuclear test or event. According to the fact sheet distributed by your agency, the study on Operation Crossroads is scheduled to be the last one released.

In light of the documents on Operation Crossroads, and the fact that 42,000 veterans were in or near or around that area, wouldn't it make sense to move up the analysis of that documentation to not being the last area to review, but one of the first areas to review, given the large number of veterans who were involved?

General **Griffifh**. Mr. Edgar, I am sure that you can appreciate that when you attack a problem this large and this massive, a certain amount of prioritizing has to be done. In our general concept we tried to select those shots where we could best correlate dose reconstruction with actual film badge readings.

We also wanted to pick those shots where we felt we could generate the greatest amount of information that could be used early on.

I appreciate that this information has come to light very recently. I can assure you that we will carefully examine it and use it to the fullest.

Mr. **Edgar**. I would like to take my time to read from two of the documents, one by Stafford L. Warren, consultant to the Joint Crossroads Committee. Point four of his memo that is dated June 8—actually its classification was canceled on June 8, 1965, this is a document dated January 18, 1947.

In point four it says,

> In view of the experience with this whole subject in the past, the subject of radiation tolerances, it is my recommendation that no attempt be made at this time to fix a range of tolerance for military operations. Once they are stated in writing or put in a manual, they are almost impossible to change. They would hardly be worth the paper they were printed on and would be misleading in the light of subsequent findings.

He goes on in this document, particularly, to talk about what a massive legal dose would be and analyzes some of the defections of some of the equipment.

And then on December 31, 1946, again, Stafford L. Warren, medical advisor to the Manhattan District, in a letter that he sends to Dr. William Myers, Department of Medicine, Ohio State University, Columbus, Ohio, says a couple of things.

Let me quote two paragraphs.

> The Bikini tests, insofar as our section was concerned, was conducted as an emergency and a lot of compromises were made to meet this emergency. The tests turned out to be literally 100 times larger than the original conception.
>
> We had not time to train sufficient men to do the job, but had to strip the Manhattan District and call upon knowledgeable civilians like yourself for personnel.
>
> We had to make decisions on instruments in order to get them manufactured and delivered. These decisions had to be made at a time when the instrument manufacturing program was nonexistent and had to be recreated and we had to make, essentially, what could be made.
>
> The 263, which is the geiger counter, had a great many defects, but it did fill one particular need, namely that of a light detection and scouting instrument. It never was designed to be a measuring instrument, although we were forced, because of the lack of other instruments, to use it as such. It will probably take 10 years of intensive work to get a foolproof set of meters suitable for war purposes.

And then in one final paragraph it says,

> After you left, we set up a chance ship to monitor the clothes and the bodies and later we monitored the urines. I don't believe you are an alarmist, but I never want to go through the experience of the last 3 weeks of August again. The air inhalation possibilities and all the rest indicated conclusively that just upon the basis of statistics alone, we were certain to get into trouble if we did not close the operation shortly. I agree entirely that the greatest hazard is the insiduous, long-time exposure to long-life isotopes and low concentration in bombed cities where the underwater detonation has been used. I believe they would be uninhabitable for several generations.

Mr. Chairman, I think as we review the materials that are available to us and as we ask further questions, I think the material indicates that the early tests were not monitored well and that radiation exposure levels, as determined by the badges and the other detection devices, are insufficient to really give us a full understanding of exposure to radiation. Thank you.

Mr. MONTGOMERY. Thank you.

The Chair thanks the witnesses. We appreciate your coming here this morning, General Griffith.

General GRIFFITH. Thank you, Mr. Chairman.

Mr. MONTGOMERY. I would like to call to the witness table Dr. D. Earl Brown, who is the Associate Deputy Chief Medical Director of the Veterans' Administration; and Dr. James Smith, Director of the Nuclear Medicine Service.

Welcome, gentlemen. You may proceed.

STATEMENT OF DR. D. EARL BROWN, ASSOCIATE DEPUTY CHIEF MEDICAL DIRECTOR, VETERANS' ADMINISTRATION, ACCOMPANIED BY DR. JAMES J. SMITH, DIRECTOR, NUCLEAR MEDICINE SERVICE; MAX R. WOODALL, DIRECTOR, COMPENSATION AND PENSION SERVICE; RICHARD STANDEFER, DEPUTY VICE CHAIRMAN, BOARD OF VETERANS APPEALS; AND RALPH IBSON, DEPUTY ASSISTANT GENERAL COUNSEL

Dr. BROWN. Mr. Chairman, I would like to introduce those accompanying me. You have introduced Dr. Smith already. On my left is Mr. Ralph Ibson, the Deputy Assistant General Counsel of the Veterans' Administration. On my far left is Mr. Max Woodall, the Director of Compensation and Pension Service and on my far right is Mr. Richard Standefer, the Deputy Vice Chairman of the Board of Veterans Appeals.

Mr. MONTGOMERY. I know Richard Standefer. He is probably one of the better tennis players in the country and we are glad to have him here today.

Mr. STANDEFER. Thank you, Mr. Chairman. You are very kind.

Dr. BROWN. Mr. Chairman and members of the subcommittee, I am pleased to appear before this subcommittee this morning to discuss important issues related to the exposure of veterans to ionizing radiation during military service.

This forum is a welcome opportunity to describe the Veterans' Administration's program under Public Law 97-72 to provide medical examinations, care and treatment for veterans with disabilities which may be associated with radiation exposure.

In January 1978, the Veterans' Administration began a program to provide a medical examination upon request to any veteran who participated in nuclear weapons testing programs. At that time a medical examination protocol was developed which required that a history of exposure be elicited from the veteran.

It also required performance of a complete physical examination with particular attention paid to organs thought to be most commonly affected by exposure to radiation.

In March 1979, in cooperation with the Defense Nuclear Agency, the Veterans' Administration began a notification and a medical examination program for all weapons test participants with recorded ionizing radiation doses in excess of 25 rem. At the time, 25 rem was the recommended maximum allowable exposure for persons receiving a one-time planned exposure in an emergency situation.

A new medical examination protocol was developed for the use in this new program. It was also used for the general examination program which had begun the year before.

The notification and examination program was expanded in June 1979 to include all weapons test participants with recorded annual doses in excess of five rem. With enactment of Public Law 97-72 in 1981, the VA received special authority to provide hospital and nursing home care and limited outpatient services to certain veterans exposed to ionizing radiation.

The law authorized care for such veterans who participated in the nuclear weapons testing programs or who served with the occupation forces in Hiroshima, or Nagasaki, Japan.

Care was authorized for any disability which may be associated with exposure to ionizing radiation notwithstanding that there may not be sufficient medical evidence to determine that the individual's disorder was caused by the exposure.

Initial guidelines implementing Public Law 97-72 authorized the Veteran's Administration to provide eligible veterans with care and treatment for cancer and thyroid nodules. Those guidelines provided that all other conditions are not ordinarily attributable to exposure to ionizing radiation.

Following complaints that the eligibility guidelines were too restrictive, particularly when compared with similar guidelines related to agent orange, the radiation guidelines were thoroughly reviewed. We determined that we could, consistent with the intent of Congress when Public Law 97-72 was enacted, revise the guidelines to allow treatment for all conditions except those which are known to have causes other than exposure to ionizing radiation. Accordingly, the guidelines were amended on April 5, 1983.[1]

Health care personnel responsible for treating veterans for illnesses possibly associated with radiation exposure must be aware of the developments in scientific and medical understanding of diseases for which treatment is being offered, including research on the etiology of the diseases.

To this end, we are, together with Society of Nuclear Medicine, preparing a detailed manual for use by health care personnel that will assist them in treating veterans with illnesses which may be related to radiation exposure.

It will set forth examination protocols, identifying organs or organ systems which particularly should be examined. It will also serve as a basic resource manual and contain reference material, specifically abstracts from pertinent articles.

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[1] See p. 268.

The VA is also in the process of setting up a system to maintain accurate records regarding both the numbers of veterans seeking examination and those seeking treatment under Public Law 97-72. This will establish a tracking system to enable us to identify and follow the veteran.

When this system is in firm place, we will be able to obtain aggregate information on how many veterans are being treated under the authority of Public Law 97-72 for care for disabilities which may be related to exposure to ionizing radiation.

Finally, the VA is preparing a pamphlet which will describe the medical benefits authorized by the law and which will provide information on how to obtain examination and treatment.

That concludes my prepared statement. I will be happy to answer any questions the chairman or the members have.

[The prepared statement of Dr. Brown appears on p. 263.]

Mr. MONTGOMERY. Dr. Brown, I only have two questions. When will this detailed manual be completed and distributed?

Dr. BROWN. It will be complete and ready for distribution by August 1.

Mr. MONTGOMERY. For service-connected radiation exposure, how many have been classified for service-connected compensation by the Veterans' Administration?

Dr. BROWN. Mr. Woodall?

Mr. WOODALL. Sixty-nine so far.

Mr. MONTGOMERY. Sixty-nine? On what authority does the administrator declare these as service-connected in relationship to radiation?

Mr. WOODALL. This could be due to exposure or instances in service other than the ionizing radiation we are talking about now. It could be part of their assignment within the service. It has some direct connection, in most cases, with their military service. In most of the allowed cases service connection was found on the basis that diseases or injuries were shown to have been incurred in service, and it was not necessary to decide if radiation played any role.

Mr. MONTGOMERY. And the Administrator—I am not really trying to trick you in any way, I am just really trying to gather information—the Administrator does have this authority in the number of cases that can be declared as service-connected from their military service?

Mr. WOODALL. Yes, he does. But this may or may not be due to the type of study that you are talking about here. It could be something——

Mr. MONTGOMERY. But could it apply to this hearing this morning pertaining to the radiation?

Mr. WOODALL. Yes; it could.

Mr. MONTGOMERY. Thank you.

Mr. Sundquist?

Mr. SUNDQUIST. Thank you, Mr. Chairman.

Public 97-72 that you referred to has been in effect since 1981. Have you reached any conclusions from the tracking system as a result of that law?

Dr. **Brown**. We haven't really established a tracking system yet to follow specific individual patients. What we have done is we have conducted a survey to see how many people have responded to the passage of that law and have come to the VA for examination. Since the law was passed in November 1981, there have been approximately 34,000 who have come to the VA for examination.

Mr. **Sundquist**. The 34,000, without being——

Dr. **Brown**. I am sorry—3,400. I misstated that.

Mr. **Sundquist**. 34,000 would be an amazing number.

Has there been from the veterans organizations and from the veterans themselves, any appeals as a result of actions by the VA? In other words, are the veterans satisified that they are receiving the kind of prompt, high priority reaction to their problems?

Dr. **Brown**. As far as the provision of medical care and examinations, we have had very, very few complaints, and just in preparation for this hearing, we have been talking with several of the directors to see if indeed they have received complaints and the complaints regarding medical care have been really minimal.

Mr. **Sundquist**. You heard the previous testimony, I assume?

Dr. **Brown**. Yes, sir.

Mr. **Sundquist**. Based on the comments, the questions we asked, and the answers that were given, apart from reaction to Public Law 97-72, do you have recommendations that we need additional legislation to address the problems as a result of the testing? Do you have authority to do everything you need?

Dr. **Brown**. I think we do. The Veterans' Administration has, I think, authority to do whatever we need for these veterans. They already have a high priority for examination and treatment and I can think of no other legislative requirement.

Mr. **Sundquist**. We will be asking that same question, obviously, of the veterans groups as they come before here today.

I have no further questions, Mr. Chairman. Thank you.

Mr. **Montgomery**. Thank you.

Dr. Rowland?

Dr. **Rowland**. Thank you, Mr. Chairman.

You mentioned that there were 69 veterans that are now receiving compensation because of possible radiation disability. Is that right?

Mr. **Woodall**. Sixty-nine in which radiation is allegedly the cause of disability.

Dr. **Rowland**. Would you give me a breakdown on that and tell me what disease processes those 69 people have?

Mr. **Woodall**. I don't have an exact breakdown of the 69 themselves. I have the claims and I can tell you the major groups they are in, but I do not have an exact breakdown. I can furnish it to you.

[Subsequently, the Veterans' Administration furnished the following clarifying information:]

Only 14 of the 69 veterans receiving compensation have disabilities relating to participation in nuclear device testing. In the remaining 55 cases, the disability was based upon claimed exposure to radiation, but the type of exposure was either occupational or therapeutic.

Dr. **Rowland**. Would you give me the major groups then?

Mr. **Woodall**. Yes, the major groups are leukemia and lymphocytic lymphoma—the others are scattered, very small.

Let me explain one step further. We have talked about the ability we have to evaluate these claims. We have exceptional cases that were discussed earlier about the types of exposure. Out in the field we have the ability not only to rate locally, but the rating board can submit to Central Office any case, particularly in what they call "exceptional circumstances," that is, the exposure itself is not within these normal ranges.

These cases can be submitted to Central Office for advisory opinion, and in addition to that, we routinely receive and review a copy of each radiation rating done in the field. So each radiation rating is actually reconsidered by the Central Office personnel.

So to go back to your question earlier, I think we do have the ability to look at the entire picture, the longitudinal picture of the veteran and generally I think we are doing a good job of evaluating the process, the exposure and their circumstances.

Dr. **Rowland**. I would like to have a breakdown of those, if you could get that to me.

Dr. **Brown**. We will provide that for the record.

Dr. **Rowland**. Thank you.

[Subsequently, the Veterans' Administration furnished the following information:]

I. SERVICE-CONNECTED DISABILITIES IN CASES INVOLVING A-BOMB TEST PARTICIPATION

Carcinoma—7: Basal cell (2); Bronchogenic; Lymphoma; Renal cell; Thyroid; Undifferentiated.

Leukemia—7: Acute granulocytic; Acute myelogenous; Hairy cell; Leukemia (undifferentiated) (2); Monomyeloblastic; Myelocytic;

Radiation Burns—3: Anxiety reaction; Chorioretinitis, bilateral; Hyperparathyroidism; Vitiligo.

II. SERVICE-CONNECTED DISABILITIES IN CASES INVOLVING OCCUPATIONAL OR THERAPEUTIC EXPOSURE

Cancer—13: Basal cell (5); Lower lip; Lymphoma/lymphosarcoma (2); Mandible; Squamous cell; Thyroid (2); Testicle.

Leukemia—2: Acute myelogenous; Leukemia (undifferentiated).

Radiation burns—4; Radiodermatitis—5; Cataracts—4; Alopecia—2; Anemia—2; Enteritis—2; Hyperparathyroidism; Leukacytosis—2; Osteoporosis—2; Aphakia, bilateral; Chronic obstructive pulmonary disease; Leukenoid reaction; Loss of teeth; Loss of use of left foot; Necrosis of chronic ulceration; Osteonecrosis of the mandible; Paralysis of right cheek; Sterility.

Mr. **Montgomery**. Mr. Evans.

Mr. **Evans**. I have no questions, Mr. Chairman.

Mr. **Montgomery**. Mrs. Johnson.

Mrs. **Johnson**. Just briefly. Could you also give us some information about the 3,331 whose claims were denied? In other words, what kinds of illnesses are they suffering from and on what basis is the decision made that it is not exposure related?

Mr. **Woodall**. Yes, I do have those with me. There is a total of 1,466 who claimed exposure at the eight atomic tests. These are scattered in a total of 18 major breakouts. Again, looking at the largest one, respiratory cancer accounts for 215 of those.

In the next group would be G.I. cancer at 130, skin cancer at 114, and G.U. cancer at 106. We have six leukemia classifications. The largest classification has 28, the smallest has 2. The next category is endocrine cancer at 26; the musculoskeletal at 26; and the others are all smaller than that.

Mrs. **Johnson.** On what basis do you make the determination as to whether a leukemia case is service connected or not service connected?

Mr. **Woodall.** Well, there is no way, as the previous testimony pointed out, that you can distinguish between the cancer caused by the exposure at the test and the ones that are picked up in industrial exposure and ordinary exposure.

We do have an environmental physician, a specialist at all facilities. The local rating boards have the ability to go to that physician for assistance in those exceptional cases. As I stated earlier, they can also come to us for an advisory opinion if they have something about the amount of exposure that's questionable or some other part of his or her military service might lead us into another area.

But we look at the overall picture and we attempt to establish service connection by the entire picture. We look at many things other than just exposure itself.

Mrs. **Johnson.** Do I understand you correctly then that the other cases are other kinds of cancer, that all of the other groups fall into other types of cancer, the respiratory, skin or other types?

Mr. **Woodall.** Of the 1,466 denied claims by or on behalf of test participants, only 813 involve cancer of various forms.

Mrs. **Johnson.** Considering the earlier testimony about the inability to determine, to differentiate an origin, it seems to me that it must be very difficult. I would be interested in knowing how the conclusion was drawn that six of the leukemias were not eligible for disability and the rest were and likewise in the other cases.

Mr. **Woodall.** That's why we rely on the experts, as we have. These are difficult cases—you would call them "exceptional cases" and we would necessarily apply what we called a "rule of reasonable doubt" in these cases. That means we reach to the edge of any doubt, what we would call "reasonable doubt," but we stop short of speculation on remote possibility.

Mrs. **Johnson.** I appreciate that, but that is a judgment. Perhaps we need to understand on what basis that judgment is being made and where that line is a little bit more clear because there is not any way at present at the point of origin to determine what the cause is.

Dr. **Brown.** Mrs. Johnson, perhaps Dr. James Smith, who is the director of nuclear medicine, could assist you with that because he sees in consultation the cases that are sent to Central Office.

Mrs. **Johnson.** OK.

Dr. **Smith.** Thank you. I think it's very important to understand right from the beginning that the way in which we approach these problems is really that of inquiry; it's really the way that you folks are approaching the problem today.

The life of a physician is a life of constant inquiry and when we are asked to look at the records of a veteran in which it's doubtful whether or not he may have contracted cancer or some other disease as a result of radiation exposure, we consult with experts in the general field of cancer, called "oncology," and also with people who are very knowledgeable in the field of radiation.

We do not do this on our own and per our own judgment alone. I think it's very important that people realize that we are in the middle of a process in this matter of radiation exposure and resulting illness and that, speaking for myself, I do not consider that we have all the answers at all.

We are still looking. And in white papers that I have written on this subject, I have pointed out repeatedly that if further evidence is disclosed on a given veteran or on a given disease or on a level of radiation exposure, that case can be reexamined, reopened, and a further judgment made.

I think this is of great importance. I don't think that anyone should consider that we are rigid in our outlook on this at all. We are inquiring, and similarly, with the question referred to me, we make our best possible judgment at that time, but we are quite prepared to have further evidence, further information, further knowledge presented and act accordingly.

Mr. **Woodall**. Could I explain one procedural aspect of these claims that would partially answer your question?

We do not have to have a direct causal relationship established in some of these cases. If we can establish that the condition had its inception during military service, we can establish service connection on that basis. We can also grant service connection if it is established that the condition arose so shortly after separation from military service that sound medical principles dictate that it must have originated during service, and that would account for some of those cases that you and I discussed in the leukemia area which would be questionable under any other answer.

So if it's established as having its inception during military service, we call that a direct service incurrence and we establish all of the benefits and service connections for that condition without resort to the medical causal relationship.

Does that help?

Mrs. **Johnson**. Thank you. It does help to some extent and I won't pursue this further. I appreciate very much what Dr. Smith is saying, but I do think your remarks show the difficulties. Clearly, these things are happening many years after severance from the military and it would be, I would imagine, the minority of cases in which you could establish that, for instance, the leukemia or the cancer actually started during the time one was in the military. You would be always trying to make a link over decades.

Considering how little we understand the cause of cancers to begin with, much less the role of low-level exposure of short-term or long-term duration—I guess what I am pointing out is my frustration and difficulty with the fact that we are giving disability to some and not others when we really know so little, in fact, about the whole matter.

Mr. **Montgomery**. Thank you.

Mr. Penny?

Mr. **Penny**. I have no questions, Mr. Chairman.

Mr. **Montgomery**. Mr. Edgar.

Mr. **Edgar**. Thank you, Mr. Chairman. It seems to me that what you have really done is you have determined that 69 people out of all those who have come in have service-connected compensation due them because of exposure to radiation that has caused a specific kind of cancer. Is that correct?

Mr. **Woodall**. Well, actually these would be on a direct incurrence so it would be, as I was explaining to her, generally due to an incurrence established during the military service.

Mr. **Edgar**. When filing a disability claim with the Veterans' Administration, atomic veterans are faced with several formidable obstacles. Radiation measuring equipment, as was stated before, was new and experimental at the time of exposure to radiation and it was often misleading, lost, or destroyed.

In addition, it is difficult for the veteran to prove disability because of epidemiological studies which would aid him in doing this are practically nonexistent. In light of the fact that these obstacles are the fault of the Government and not the individual veteran, do you feel it's fair that the veteran bear the burden of proof in connection with a claim rather than the Government?

Dr. **Brown**. Mr. Edgar, I don't feel that we rely upon the veteran to prove to us that he had a certain exposure. We obtain all the information we can get from DNA, who just testified, from any other sources, and if the veteran gives us any clues, we research that as well to try to find out exactly what his exposure had been and the danger he had encountered.

Mr. **Woodall**. I think that's why we left the process rather flexible so that we can accommodate these unusual cases, these exceptional cases, and refer them to Dr. Smith or to the environmental physician to attempt to grant service-connection in that type of case.

Mr. **Edgar**. Have the original guidelines for Public Law 97-72 been changed or altered recently?

Dr. **Brown**. If you are talking about the circular we issued on April 6, yes, it did change the guidelines.

Mr. **Edgar**. Could you describe for the committee that change from the original guideline?

Dr. **Brown**. Yes, sir. The previous circular had said that we would evaluate any individual who came to the Veterans' Administration with a history of radiation exposure, specifically for cancer or thyroid problems.

The new circular opens it up and says that we will evaluate anyone and treat them—with a history of radiation exposure—who have a condition for which there is no ready explanation.

Mr. **Edgar**. Do you think this will incur more veterans coming for analysis?

Dr. **Brown**. Yes; the number of veterans coming for examination has increased. Just for comparison, in 1978, when we first started giving free examination for veterans, from 1978 to early 1982, there were 4,000 who responded to the DNA letters. We have had 3,400 who have come in just since the beginning of 1982, with the implementation of the new Public Law 97-72.

Mr. **Edgar**. My final question is that I was interested in your presumption that you don't mandate causality, you pretty much presume that causality. What specifically gives you the scientific data to presume causality relationship to thyroid and to certain forms of cancer and not to other related diseases?

Dr. **Brown**. Mr. Woodall?

Mr. Woodall. We don't have an absolute rule as far as the presumption in this area. We have a strong indication that certain types of cancer are more predictable. We refer that to Dr. Smith or to the environmental physician for their expert evaluation of that case.

Dr. Brown. Mr. Edgar, I reviewed last night several cases that have been given service-connection and have tried to get a better understanding prior to this testimony and, as I reviewed those cases—actually these were cases from the Board of Veterans Appeals—the documented dosage we got from DNA was really minimal. But those who were considering adjudication of the case really considered the entire history of the individual and these cases that I reviewed had all given histories similar to what you have heard today.

They had gone in for cleanup, for washdown. They had eaten the food locally and the Board of Veterans Appeals gave them the benefit of the doubt. They assumed that they had had more radiation and, therefore, gave service-connected decisions.

One of them was .02 rem, just to give you an example.

Mr. Edgar. It's intriguing to find that the Veterans' Administration is more liberal than the Department of Defense in its presumption of causality and I appreciate your work.

Mr. Montgomery. Thank you, Mr. Edgar. I overlooked Mr. Staggers, a member of the subcommittee. The Chair recognizes the gentleman from West Virginia.

Mr. Staggers. Thank you, Mr. Chairman.

I applaud you for your flexibility, but I am concerned, like Mrs. Johnson, with some of the problems, especially with the flexibility. Dr. Smith indicated that there was an inquiry type of method.

My problem is what does the veteran do to get further evidence? Where does he turn to? We've already seen that the DNA, basically, has even a different, more strict type of evidence. Where does the veteran turn to, if he is turned down, where would he turn to?

Mr. Woodall. In an effort to assist the rating boards in the difficult and exceptional cases, Dr. Smith and myself just started a series of casettes. We have the first one, in which we attempt to furnish guidelines completed. These guidelines will be nonregulatory but they will direct the rating board, the veterans and their representatives toward certain areas where they can gain more evidence and, hopefully, bring some of the exceptional cases into an area where we could grant benefits.

The other sources will be searched and we will also in this presentation, "Training of the Rating Boards," try to direct their attention to any other sources that might be developed in the adjudication process of that claim.

We also have available the local hearing where the record can be expanded. At that time the rating board can assist the veteran and the representative in developing other exposure, other types of problems that might have developed in that military service, that could assist the veteran in documentation and support of the disability.

Mr. Staggers. Is there any testing for chromosome damage? Because, in my mind, you wouldn't even know you had a problem until——

Mr. Woodall. Dr. Smith?

Dr. Smith. The test for chromosome damage is something that is under considerable dispute among epidemiologists on this subject. For example, the group from Johns Hopkins that is currently making a study of Navy personnel who worked with atomic ships and atomic submarines, made the decision that they would not do chromosome studies because various kinds of chromosome breakages are very widespread in the general population, and are not specific.

They therefore felt that with lack of a specific identification, with the possible exception of the Philadelphia chromosome, as it is called, really it would not result in value to the people being studied. Chromosome tests happen to be rather expensive. They cost approximately $250 to $300 to do.

But price would not be the consideration. If they have to be done, they have to be done, and they'd have to be paid for.

But, really, the predominant scientific opinion is that they would not be of help in settling these matters.

One thing I'd like to point out that has not come out at this testimony is that the VA is organizing a framework for an epidemiological, study of all these veterans and the study that we're developing would take into consideration morbidity, sickness characteristics, mortality or death, psychological and genetic effects.

We are having a meeting on June 3 of experts in each of these areas. That is, morbidity, mortality, hematology, genetics, and psychological effects. And when this proposal for this study is completed, it will be run through the Office of Technology Assessment and then presented to the Inter-Agency Radiation Research Committee for advice as to the format of the study and the feasibility of doing the study itself.

It may be that our geneticist, Dr. Neel, from the University of Michigan may say something about chromosomes, but I doubt it very much, from conversations I've had with him in the past.

Another point I'd like to make is that in the matter of the veteran—where does the veteran go for help? He comes to us, very largely. I get a great number of letters from veterans and I must say we do a good job with them. We answer the veteran himself, or if he writes to us through his Congressman, we answer through the Congressman.

Furthermore, we will notify the chief of staff of the hospital in the area in which he lives, to be alert to the fact that veteran so and so is going to come for examination and please have everything ready to take care of him.

We also encourage the hospital people to help the veteran fill out a claim, if he wants to do so. You know, it's really—we are trying to help.

Mr. Staggers. Mr. Chairman, since you overlooked me, can I ask for an additional 30 seconds?

Mr. Montgomery. Yes.

Mr. Staggers. This study that you made reference to, what effect will that have? Will that change policy if it would indicate?

Dr. Smith. As I've said, we are in a phase of inquiry and if the epidemiological study produces results that indicate a change in direction, we will make the change.

Mr. **Staggers**. OK. Thank you. Thank you, Mr. Chairman.

Mr. **Montgomery**. Mr. Daschle?

Mr. **Daschle**. Thank you, Mr. Chairman.

Dr. Smith mentioned that a veteran comes to us and I guess it's on that note that I'd like to pursue some questions. I'm unclear as to how many people actually have come to you. In total, how many have asked for examinations?

Dr. **Brown**. There are approximately 7,400 since 1978.

Mr. **Daschle**. Since 1978. And then how many have actually come to you with a claim?

Dr. **Brown**. Let's see. How many do we have? I believe the total number of cases is 3,325.

Mr. **Daschle**. So, about half of the 7,400 have actually asked for claims?

Mr. **Woodall**. They may not be the same individuals, but it appears so.

Mr. **Daschle**. Right.

Well, when was the first compensation provided? Mr. Woodall?

Mr. **Woodall**. I don't have the exact date on that.

Mr. **Daschle**. Approximately, just roughly. What year?

Mr. **Woodall**. It was a few years ago.

Mr. **Daschle**. Several years ago?

Mr. **Woodall**. Yes.

Mr. **Daschle**. Well, with my calculations I come up with about 1.8 percent of those who have come to you for claims that have actually received compensation, over the period of several years.

Now, the figure that I was told, the total number, was 29. But as I understand it now, that 29 is the total number up until the Senate hearing, because that was the number that you gave at the Senate hearing of the number of claims that have actually been compensated. Is that right?

Mr. **Woodall**. No; if that's true——

Mr. **Daschle**. That's from the Senate hearing.

Dr. **Brown**. Sixty-nine is the accurate figure as to all radiation claims decided at the local level.

Mr. **Woodall**. Yes, 69.

Mr. **Daschle**. Well, it's 69 now but what was it when the Senate held their hearing? Because that's where we got the 29 figure.

Mr. **Woodall**. OK. Well, actually, the 69 has been relatively stable. I have the 1982 figures here and it was 65 in February or March of 1982.

Dr. **Brown**. Perhaps we testified incorrectly at the hearing.

[Subsequently, the Veterans' Administration furnished the following clarifying information:]

> The 29 cases cited at the Senate hearing included 14 test participants whose claims were allowed by regional office adjudicators without regard to a cause-and-effect relationship between exposure and disability, and 15 cases decided by the Board of Veterans Appeals, all of which were allowed on a cause-and-effect basis. The total of 29 reflects only test participants at both adjudication levels while the 69 includes occupational and therapeutic exposure claims decided at the original adjudicative level.

Mr. **Daschle**. Well, I guess that clarifies it then. You've had about, over the last several years 65 claims, and as of March of

1982 you had about 65, so in the last year you've provided four additional veterans with compensation.

Mr. **Woodall**. Let me check on that number. I've got it.

Mr. **Daschle**. The figure, whether it's 64 or 69, in essence what we're talking about is less than 2 percent of the people who have come to you for claims have actually received compensation. So regardless of how nicely you fill out the forms, the actual prospects of getting compensation are pretty bleak.

Is that not correct?

Mr. **Woodall**. Your percentages are approximately correct. We have 2.1 percent in our figures. That's why we need to be especially helpful in the exceptional cases, to assist them, and we need to direct them to the other sources to attempt to fill out their record.

Dr. **Brown**. Mr. Daschle, I think it depends primarily upon how many of the individuals coming to us with claims have legitimate claims. I don't think any percentage would really measure that.

Mr. **Daschle**. So, in other words, what you're telling those veterans is that only 2 percent of those who come to you have legitimate claims?

Dr. **Brown**. Thus far.

Mr. **Woodall**. Yes.

Let me point out that really, there actually are a great number of cases that have no diagnosis at all. They're just making a claim for the record. There are 1,004 cases that have no diagnosis at all.

Mr. **Daschle**. No diagnosis of what?

Mr. **Woodall**. Of any disability.

Mr. **Daschle**. They're just filing claims because they just need the money, then, or what?

Mr. **Woodall**. No; they're filing claims, I think, in anticipation of some either a possible disability later on or maybe some further breakthroughs.

Mr. **Daschle**. So actually it's not 69 out of 3,400 who have disabilities; it's probably 69 out of 2,400?

Mr. **Woodall**. That's approximately correct, yes.

Mr. **Daschle**. That's a whole lot better.

Let me ask you about the documented dosage. Judging from what Colonel Warren said and what the decontamination report said, there is absolutely no way that we can document the dosage level. And yet I'm concerned by some of your remarks this morning that perhaps we are putting a great deal of emphasis on what documented dosage might be in a veteran's report.

How do you relate the documented dosage which, by our own governmental reports, are very inaccurate, to their claims for compensation?

Dr. **Brown**. Mr. Daschle, that's the reason we don't rely entirely upon the documented dosage and we use judgment, depending upon the history and the activities of the individual during the nuclear testing, where he moved about, what jobs he had, whether or not he ate there, whether he swam. In one case that I reviewed last night, we assumed that his dosage was higher because helicopters had hovered over and stirred up the dirt around him repeatedly and therefore he was given the benefit of the doubt, and he was given service connection.

Mr. **Daschle**. You give the benefit of the doubt to the veteran?

Dr. **Brown**. That's accurate.

Mr. **Daschle**. You can say that when only 1.8 percent of the veterans have received compensation and you're telling me you're giving them the benefit of the doubt?

Dr. **Brown**. I say it, Mr. Daschle, because I believe it. That's accurate.

Mr. **Daschle**. Thank you.

Mr. **Montgomery**. Dr. Rowland?

Dr. **Rowland**. Thank you, Mr. Chairman, I have a little additional information and some followup on what Mr. Daschle was talking about. Those who filed claims and claimed exposure in a test there were 1,466 that were denied. Fourteen were allowed; 1,466 were denied. Of those 1,466 there were 813 who had malignant diagnoses of various types of leukemia, lymphocytic lymphoma, Hodgkin's disease, melanoma, several other things, and my question, and I guess I'm going to ask you to repeat what you've already said, is you don't have any real definite guidelines to go by to determine whether or not this would be an allowable claim? It's sort of a judgment call, in a way. Is that not right?

Dr. **Brown**. That's accurate.

Dr. **Rowland**. OK.

Do you think that we should have something, some method, that would remove some of that judgment calling, some more accurate or more definite guidelines to go by? Can such guidelines be developed?

Dr. **Brown**. Dr. Smith, would you like to respond to that?

Dr. **Smith**. I'd like to answer that question, Dr. Rowland.

We made a survey in early 1979 of five or six eminent experts in the matter of radiation exposure, Warren Sinclair, who is now president of the National Council on Radiation Protection and Measurements, Dr. Adelstein of Harvard, who is a specialist in this field, Dr. Kaplan on the west coast, people of this caliber, and asked them to list for us their estimate of the probabilities of cancer occurring as a result of radiation exposure and they furnished us a hierarchy, if you will, of diseases that might occur with leukemia at the top and then, let us say, cancer of the foot, at the bottom just to make it extreme.

We have used that as a guideline in terms of probabilities. That is, the development of leukemia is undoubtedly much more probable as a result of radiation exposure than, let us say, cancer of the pancreas.

But beyond that, we are greatly interested in the radio-epidemiological tables that the Secretary of Health and Human Services has been mandated by Congress to produce by January of 1984. We think that, although again we will not—suppose, for example, the radio-epidemiological table said that this particular veteran with this particular cancer has a 4 percent probability of cause and effect relationship. We would not be limited by that. We, the Department of Veterans Benefit or the Board of Veterans Appeals might very well say, "Well, the probability of cause and effect of 4 percent is so low that the claim is not allowable, but in view of the circumstances in which he worked," as Dr. Brown has described, and as Mr. Woodall has described, we would give him the benefit of the doubt and say, "OK, the tables, with the exposures listed, deny his claim, but that's just a table judgment. We're human beings and we're going to make a human judgment," and we would give him the benefit of the doubt.

However, these epidemiological tables are going to bring considerable order into a rather confused situation.

Dr. ROWLAND. Then you are saying that we will have something in the future that might help us better?

Dr. SMITH. Yes.

Dr. ROWLAND. We are now prepared to make the assessment?

Dr. SMITH. Yes, definitely.

Mr. SUNDQUIST. Will the gentleman yield?

Dr. SMITH. Yes, I'll yield.

Mr. SUNDQUIST. Did I understand you to say, Dr. Smith, that, for example, that leukemia would be more prevalent, as a result of what happened in the testing than some other diseases?

Dr. SMITH. Well, I would say, Mr. Sundquist, that I believe it's prevailing knowledge that leukemia is more likely to occur from exposure to ionizing radiation than, let us say, cancer of the pancreas.

Mr. SUNDQUIST. Would you furnish this committee with the information on the statistics on those who have had leukemia who have been accepted for assistance as opposed to those who have been rejected?

Dr. SMITH. May I ask the Board of Veterans' Appeals to do that? They have all those statistics.

Mr. SUNDQUIST. If you would, I think it'd be interested to see that.

Dr. BROWN. We'll furnish that.

Mr. SUNDQUIST. Thank you.

[Subsequently, the Veterans' Administration furnished the following information:]

As of June 1, 1983, there had been 2,143 claims filed by veterans who alleged exposure to radiation as a result of participation in nuclear weapons testing. Fourteen claims were allowed, 1,491 were denied and 638 were denied because no disability was alleged. Within the 1,491 claims that were denied, there were 106 cases of leukemia.

There have been 1,297 claims by veterans who alleged exposure to radiation from sources other than nuclear weapons testing. Four hundred and five of these claims were from veterans who alleged exposure as a result of participation in the occupation forces of Hiroshima and Nagasaki. Within those claims, there were 203 claims for leukemia and other malignancies. None of these were granted service connection.

Mr. SUNDQUIST. Thank you, Dr. Rowland.

Mr. MONTGOMERY. Thank you, Dr. Rowland. As chairman of the committee, I'd like to say that I'm very glad to hear you say today, Dr. Brown, that you do give the benefit of the doubt to the veteran and that you do have the attitude of compensating those with legitimate claims. You certainly try to compensate, and I certainly agree with this.

Also, for members of the committee, I wish that all claims filed, that you could take care of them. But I understand the money crunch that we're in and you can't pay every claim that is filed unless they are ruled valid under current VA procedures—we only get so much money, which means we'd have to come back on this committee and maybe not give a cost-of-living increase to those who have been severely wounded or we'll have to come back and close up a wing of a hospital or close up some veterans' hospitals. It's that simple.

I wish we could pay all the claims, and I understand the tough, tough job you have in identifying those with claims who deserve to be compensated. I know you will continue to try to do the best you can under the guidelines and under the circumstances that take place in these claims. Thank you very much for being here this morning.

Dr. **Brown**. Thank you, Mr. Chairman.

Mr. **Montgomery**. The next witness is Dr. Glyn Caldwell. It's quite a long title here, Deputy Director, Chronic Diseases Division, Center for Environmental Health, Centers for Disease Control, Department of Health and Human Services. Dr. Caldwell? We will include your statement as a part of the record.

STATEMENT OF DR. GLYN CALDWELL, DEPUTY DIRECTOR, CHRONIC DISEASES DIVISION, CENTER FOR ENVIRONMENTAL HEALTH, CENTERS FOR DISEASE CONTROL, DEPARTMENT OF HEALTH AND HUMAN SERVICES

Dr. **Caldwell**. Mr. Chairman, members of the committee, thank you for the opportunity to discuss the epidemiologic study being conducted by the Centers for Disease Control on the nuclear test participants present at the atmospheric nuclear test Smoky. I am Dr. Glyn Caldwell, the CDC lead epidemiologist.

I will limit my remarks to a brief review of our study and some findings that have recently been submitted for publication. In 1977 a former CDC employee saw a leukemia patient in consultation in a veterans hospital. When that patient related his history of having been present at a nuclear test, the consultant suggested that CDC be contacted, since we have been interested in studying leukemia clusters, cancer clusters, and cancer or leukemia that is found in unusual circumstances such as animal, chemical, viral, genetic, or radiation associations.

Since ionizing radiation is a well-known cause of increased risk for cancer, this case, if in fact it was related to nuclear radiation, raised the possibility that radiation levels, though safe, might actually be carcinogenic, that radiation exposure during this nuclear test might have been greater than expected, or that some accident had occurred.

Initial inquiries confirmed that the individual had been present at a nuclear test, that the nuclear test had involved troop participation, and that radiation exposures were reported to be safe. We sought the identification of all participants at this test and found that complete identifications were unlikely since no systematic records of participation had been kept.

Ultimately, we received a list of 3,153 individuals from the Surgeon General of the Army, on April 25, 1977. We ultimately included a total of 3,217 persons in the study.

The major part of the study since that time has been to locate those persons, beginning only with their names, service numbers, units, rank, and a single film badge reading. Since then we have sought additional data such as birthdates, social security account numbers, addresses, and medical histories. This required that we search through the Department of Defense, Department of Energy, Veterans' Administration, Internal Revenue Service, Social Security, FBI, and a number of State and private physician and hospital records.

This has been a time-consuming and frustrating effort. However, we have completed the major part of this effort. We have confirmed that of the 3,217 persons that were present during the detonation of Smoky on August 31, 1957, we have located 3,072, or 95.5 percent of those individuals, but cannot locate or determine the vital status of 145. Twenty persons refused to be included in the study, but for the most part did indicate that they were well and provided some confirmatory data.

In this group of 3,217 individuals, we would have expected 117 cases of cancer to occur if they were the same as any usual group with this same age makeup in the United States. We found 112 cases of cancer. However, 10 were leukemia cases, which is compared to the 4 cases expected at the end of 22 years. This latter finding is statistically significant.

According to U.S. mortality statistics, 365 deaths from all causes would have been expected in this population in the 22 years since 1957. In fact, 320 deaths have occurred, 45 less than expected.

We also calculated the expected number of deaths for cancer to be 64.3 during the intervening 22 years. In fact, we found 64. Again, leukemia deaths occurred more frequently; nine observed versus 3.1 expected. This too is a statistically significant difference.

One other disease, polycythemia vera, was also noted to have occurred at a higher frequency than expected. We would have expected no more than one case, and found four. This data is being prepared for publication.

In summary, we have found an increased frequency of polycythemia vera and leukemia, but not other cancers or other causes of death. Furthermore, this group of participants have not died at an excessive rate during their 22-year followup period, since less deaths than usual were observed.

Mr. Chairman, this is the status of CDC's followup study of nuclear test participants. I will be happy to answer any further questions that you or other members of the committee may have.

[The prepared statement of Dr. Caldwell appears on p. 270.]

Mr. MONTGOMERY. Thank you, Dr. Caldwell.

Basically, what you've said is that it's hard to tell on those persons in the one test site that you made a study on, whether it was caused by the exposure to this low-level radiation, or whether by natural causes, that individuals developed cancer. Is that simplifying it?

Dr. CALDWELL. That's correct.

Mr. MONTGOMERY. Is that too simple?

Dr. CALDWELL. It may be a bit too simple. In general, what we can say is that this population is different from the U.S. average and that radiation was one of the things that they were exposed to. But there is no way to say, with precision, that radiation made this difference.

Mr. MONTGOMERY. The radiation stood out—specific high figures, but it didn't show up in the study that you've done?

Dr. **Caldwell**. Of course, we selected the group because they were at the test site. So, automatically you know that they had an exposure difference.

Mr. **Montgomery**. Mr. Sundquist?

Mr. **Sundquist**. Thank you, Mr. Chairman.

Dr. Caldwell, I'm impressed with the tenacity of trying to locate all those individuals that you did and how amazing it is that you were able to find them. I compare that with the lack of success, Mr. Edgar, that some of the folks who are investigating agent orange have had in not being able to track people down, and I think you're to be complimented.

I glanced through your testimony before the last witnesses and I asked the question there in regard to leukemia because based on what you've said, your study shows that there's something unusual about the high incidence of leukemia among the participants, at least in this test.

Dr. **Caldwell**. Yes, sir.

Mr. **Sundquist**. I'm anxious to find from the VA what the results are that they have in terms of who they have turned down and why on leukemia. I don't know if it's possible for you to comment on that, but if it would be possible, after we get those statistics, I'd like to have your comments on that, if that's possible.

Dr. **Caldwell**. I believe that can be arranged.

Mr. **Sundquist**. This is not a question, but I would think it would be important, at least there's an early indication that there's something a little awry there with the high occurrence of leukemia, based on this one study, and that perhaps we ought to pursue that with the VA so that we give them more than just the benefit of the doubt, for those individuals.

Mr. **Edgar**. Would the gentleman yield?

Mr. **Sundquist**. I'd be happy to yield.

Mr. **Edgar**. Dr. Caldwell, in this area of leukemia, finding 9 cases as compared to 3.1 expected, what would be the three or four possible reasons for that? One clearly could be a statistical abnormality. What would the other reasons be, if you might speculate?

Dr. **Caldwell**. I guess there are two sets of answers to that. We, clearly, don't know the cause of cancer. We do know that there are certain individuals who inherit a susceptibility. Certain chemicals increase your risk. In animals, at least, and possibly in humans, certain viruses increase your risk and, of course, radiation increases your risk. Those are the four theoretical causes of cancer, although we don't know exactly how they work.

In this circumstance one would have to consider all of the exposures of these participants. You might consider, then, that there was a delayed effect of low-dose radiation. That's a possibility. Chance is a possibility.

The fact is that the film badges, as we discussed earlier, may not have measured everything. They did not measure, necessarily, what was inhaled. They did not necessarily measure neutrons. They did not necessarily measure what was ingested. That would have been somewhat different. And I would assume that you can always invoke some other unknown kind of exposure that was synergistic with this radiation exposure.

Mr. **Edgar**. Thank you.

Mr. **SUNDQUIST**. Thank you, Mr. Chairman.

Mr. **MONTGOMERY**. Dr. Rowland?

Dr. **ROWLAND**. Dr. Caldwell, do you have enough information now to determine what types of leukemia may be most likely caused by ionizing radiation, whether it's lymphocytic, myelogenous, undifferentiated, and whether it's acute or chronic?

Dr. **CALDWELL**. I think over the years and through all the studies, including some of the medical exposure studies where the radiation was used as therapy, everyone considers that almost any of the leukemias except for chronic lymphocytic leukemia can be associated with ionizing radiation.

There is no evidence that chronic lymphocytic leukemia is increased under those circumstances.

Dr. **ROWLAND**. Thank you, Dr. Caldwell. Thank you, Mr. Chairman.

Mr. **MONTGOMERY**. Mr. Evans?

Mr. **EVANS**. Doctor, I understand that there's a discrepancy in DOD statistics in regards to the number of actual onsite participants at the Smoky detonation. Originally it was stated that some 3,200 persons were at the site. But you reported that the after action reports of Smoky showed only about 2,200 participants. Wouldn't this make a substantial change in the number, make the incidence rate of leukemia even more significant?

Dr. **CALDWELL**. The figure 2,200 that was reported in the after action reports is simply a number. I don't know who that represents or exactly what it represents. We then developed the list of individuals, the 3,153 that actually had a film badge on that date. That was the data that was released to me by the Surgeon General of the Army.

We have added to that any individual who had orders that clearly placed him at the test site. We tried not to eliminate anybody unless we could show, with some fact, that he was elsewhere. A simple example is an individual who wrote me and said, "I wasn't there that weekend; I went away on sick leave," or "I was in the hospital." Sometimes that's the way it occurred.

Other times we included him because we could not be sure.

Mr. **EVANS**. No further questions, Mr. Chairman.

Mr. **MONTGOMERY**. Thank you. Mr. Staggers?

Mr. **STAGGERS**. No questions.

Mr. **MONTGOMERY**. Mr. Penny?

Mr. **PENNY**. Thank you, Mr. Chairman.

Dr. Caldwell, your coverage of the disease polycythemia vera is very abbreviated in the testimony here. Could you give us some more detail on the symptoms and the manifestations of that disease?

Dr. **CALDWELL**. Polycythemia vera is a disease with an absolute increase in the red cell mass. Leukemia, if you will, is an increase in the number of white cells. Polycythemia vera has been found in a number of individuals. It is relatively rare in young males, and that's why I think we have found less than one case expected and four observed.

It is a disease that may occur under two circumstances. One is the primary circumstance called polycythemia vera. The other is the secondary circumstance, individuals with heart disease, lung disease, or renal disease under some circumstances, and individuals who move from the seacoast to high mountaintops will increase their number of red cells in response to an oxygen need.

In polycythemia vera you must have, to make the diagnosis, a normal oxygen saturation in the blood. There are other symptoms, of course, enlarged spleen. They may have some clotting problems, et cetera. But, in general, it is a specific diagnosis with an abnormal bone marrow, abnormal red cell count, and a normal oxygen saturation.

Mr. **Penny**. You've indicated in your testimony that a report on the polycythemia vera findings will be submitted to a medical journal. Does that include conclusions about why you feel the increased incidence of that disease was evident in this population?

Dr. **Caldwell**. We don't know why it was increased. That is reported.

Mr. **Penny**. So, this report will not include any conclusions?

Dr. **Caldwell**. No. It will include conclusions that it is increased and that we have looked at the exposures of these individuals. But it will not say that it was cause and effect. I don't think that's warranted under these circumstances.

Mr. **Penny**. In followup to Mr. Edgar's question on leukemia, are you in the process now of studying the leukemia cases in this population to determine the direct relationship that might exist between their exposure to radiation and their contraction of leukemia?

Dr. **Caldwell**. I don't think an epidemiologic study can do that directly. We can look at the exposure that they had. We have collected that exposure data and know that the Smoky group in general received approximately 466 millirems of radiation, that the leukemia cases received slightly over 1 rem of radiation on the average of 9 individuals. One individual had no measured dose.

But to go back and try to determine whether or not they had more or less, I don't think it's possible in this kind of a study.

Mr. **Penny**. So, in both cases you'll be submitting findings, but you won't be trying to draw any scientific conclusions about the relationship to radiation exposure for either the leukemia victims or the polycythemia vera victims?

Dr. **Caldwell**. I think we'll be providing conclusions of an increased risk in this group compared to U.S. averages. We will not be able to say that it was necessarily due to radiation, no.

Mr. **Penny**. Thank you.

Mr. **Montgomery**. Mr. Edgar?

Mr. **Edgar**. Thank you, Mr. Chairman.

On page 1 of your testimony you make the following comment:

> Since ionizing radiation is a well-known cause of cancer, and particularly of leukemia, the case reported to CDC, if, in fact, it was at all related to nuclear radiation exposure, raises two possibilities. One, that radiation levels previously thought safe might actually be carcinogenic, or two, that radiation exposure during nuclear tests might have been greater than originally supposed.

Which, if any, of those two propositions do you think is relevant, given your information on the Smoky test?

Dr. **Caldwell**. I think the simple thing is that we can't answer the question. The only data we have, of course, is the film badge data provided by the Department of Energy, and we did collect all of the film badge data for 1957, and most of the group were there only during this test series.

All we can say is this is a characteristic of the population. I cannot make a choice but they are still distinct possibilities and there are, if you will, reasons for both.

Mr. EDGAR. Let me see if I can clarify what you're saying, that you think that there will never be an opportunity for us to determine whether or not radiation levels previously thought safe might actually be carcinogenic?

Dr. CALDWELL. Not from this group.

Mr. EDGAR. Not from this group?

Dr. CALDWELL. Right. There are numbers of people who have low level exposure through occupation who are well documented. That might be used. So, I could not say never. But from this group I don't think it's possible.

Mr. EDGAR. And it's not possible from this group to determine whether radiation exposure during nuclear tests might have been greater than originally supposed?

Dr. CALDWELL. Without any other data except for the film badges, and we know they did receive at least some exposure, I think all you can say is this is a minimum. We don't know what a maximum would be under these circumstances.

Mr. EDGAR. So that the Smoky test isn't going to be able to determine either of these possibilities?

Dr. CALDWELL. It was not a study of radiation but only of the incidence of disease in this group.

Mr. EDGAR. Why is it mentioned, then, here to deal with these two possibilities?

Dr. CALDWELL. That was the primary reason we got into the study, because of the claim that it was radiation-related.

Mr. EDGAR. So, you're saying that as a result of your study you're not going to be able to answer the primary questions raised in the original protocol?

Dr. CALDWELL. That's correct. But we did confirm the claim that there was an increased leukemia in this group.

Mr. EDGAR. And you can't take that speculation on leukemia and deal with either of these two possibilities?

Dr. CALDWELL. No.

Mr. EDGAR. Could you make available to this committee the raw data of the Smoky study or is that too extensive?

Dr. CALDWELL. I can soon provide an article with tables that would include all of the exposure data. The article has been accepted for publication, and as soon as it is published I will forward a copy to you. If you then want additional information, I will be glad to try to provide it.[1]

Mr. EDGAR. Did you find any increased incidents of cardiovascular disease?

Dr. CALDWELL. No.

Mr. EDGAR. In any population?

Dr. CALDWELL. As far as mortality is concerned, we have less than expected.

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[1] See p. 281.

Mr. **Edgar**. Let me just return to this one point and then I'll close the questioning. Can you conceive of any study that your particular center could undertake that could give us information on the two possibilities raised by the original protocol?

Dr. **Caldwell**. I'm not at all certain that we could, at least with the nuclear test participants, for the simple reason that we will always be left with a very large number of participants that we cannot determine with great precision their exposure.

So, to answer the low-level question, you're left with roughly a group that may not have enough exposure data. And second, having gone through this exercise with a very small group, it would be extremely difficult, I think, to find all of them.

So, for the nuclear test participants, I don't think that's possible. I think it's just too cumbersome.

Again, the occupational exposures maintained by reactor sites, et cetera, where there is routine film badging of individuals over time, may provide that answer. But I don't think this group will.

Mr. **Edgar**. Is there any evidence in that body of evidence that radiation levels previously thought safe might actually be carcinogenic?

Dr. **Caldwell**. There have been at least one or two papers published, one is the Mancuso study from Hanford. The other is a paper published about nuclear submarine workers at Portsmouth. There is another study being undertaken by Dr. Matinowski at Johns Hopkins. The first two are highly controversial and probably will not answer the question; Dr. Matinowski's study may.

Mr. **Edgar**. Thank you very much.

Mr. **Montgomery**. Thank you, Mr. Edgar, and we'd like to thank Dr. Caldwell for the helpful testimony and thank you, sir.

The Chair would like to call to the witness stand Mr. Seymour Jablon, who is with the Medical Followup Agency, National Academy of Science. The Chair would like to ask Dr. Rowland to take the chair.

STATEMENT OF SEYMOUR JABLON, MEDICAL FOLLOWUP AGENCY, NATIONAL ACADEMY OF SCIENCES

Dr. **Rowland**. You may proceed, Dr. Jablon.

Mr. **Jablon**. Mr. Chairman and members of the committee, I am glad to be able to tell you something about what's known concerning the health effects on humans from low levels of ionizing radiation. I understand that your interest centers particularly upon adverse health effects in veterans who were exposed to radiation at tests of nuclear weapons, or who served as occupation troops at Hiroshima or Nagasaki, shortly after the atomic bombings of those cities.

I'm on the staff of the National Academy of Sciences and Director of its Medical Followup Agency. I have spent 6 years in Japan participating in the followup studies of the atomic bomb survivors in Hiroshima and Nagasaki. I'm the Academy's staff officer for that continuing program in Japan.

I am, however, testifying today as an individual and not on behalf of the Academy. I have submitted written testimony to which a curriculum vitae is attached,[1] and I will try to be brief at this time.

Radiation in large doses of several hundred rads can cause death within a few days or characteristic immediate injuries. In small doses, however, of 5 to 10 rads at most, the effects are quite different. There are no immediate signs or symptoms but the risk of later cancer is increased.

Although there appear to be exceptions, most forms of cancer can be induced by radiation, including especially leukemia, which is a cancer of the blood-forming organs.

An important feature of these radiation-induced cancers is that they do not appear until long after the radiation exposure that caused them, at least 2 years delay for the leukemias and 10 years for the other cancers. They may continue to appear for 30 or 40 years after the exposure.

A second feature of these cancers is that they are no different from those which arise without previous radiation. There is no way to tell whether a particular cancer of the kind that can be induced by radiation has, in fact, or has not been caused by radiation.

Besides the induction of cancers, radiation can produce mutations in germinal cells, which then cause mutations in subsequently conceived offspring. I must emphasize that although these kinds of radiation effects, cancer induction, and genetic damage, do occur, they do not occur with great frequency. The United Nations Scientific Committee on the Effects of Atomic Radiation has estimated that if a population of 1 million persons were to receive 1 rad of X-ray, then 100 to 200 extra fatal cancers would be caused during that population's remaining lifetime.

Since an average population of 1 million persons will suffer about 160,000 cancer deaths, it is clear that the effect of 1 rad would not be distinguishable and the probability would be small that any particular cancer had been induced by the radiation.

The probability of a detectable genetic effect is no larger than the probability of cancer induction. I should add that the effects at the level of one rad exposure have never actually been measured. They are too few and too long delayed.

Measurements have been made only at much larger doses, 50 rads or more, and the effect of small doses has been estimated by projecting that harm is proportional to dose.

To turn from these general points to your specific concerns, after Dr. Caldwell's report appeared, showing the excessive occurrence of leukemia among veterans who had witnessed shot Smoky, it seemed essential to undertake studies on a much larger scale of nuclear test participants.

With the support of the Departments of Defense and of Energy and with the help of the VA, our group undertook studies of the mortality among some 50,000 participants in five test series, two in Nevada and three in the Pacific. These studies have not yet been completed but I can summarize quickly the essential points.

We have confirmed Dr. Caldwell's findings that a large excess of leukemias has occurred among the 3,000 Smoky participants. We have not found any excess of leukemias or of other cancers among the 52,000 participants at other tests. That, sir, concludes my statement and I will be happy to try to respond to any questions there may be.

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[1] See p. 299.

[The prepared statement of Mr. Jablon appears on p. 286.]

Dr. ROWLAND. Thank you very much.

We heard early, and you referred to this, the genetic factors that may be considered in the development of any type of cancer, and we heard this from Dr. Caldwell. Would it be true, then, to say that ionizing radiation may cause a malignancy in one person but may not cause a malignancy in another person at the same level, because of genetic factors?

Mr. JABLON. Well, I don't know why it does it. What you say is certainly true, and the best guess one can make is that it's a probability situation when ionizing radiation invades a cell. It will cause damage. Exactly what damage it will cause is a matter of chance, whether a particular chromosome or a particular location on a chromosome happens to be hit by a proton, and although I can't prove any of this, but one supposes that if exactly the right injury is produced in the cell, that will cause what's called a transformation which then, with other things happening, will eventually produce a cancer. Now, that's as much as we know.

Dr. ROWLAND. Would it be true, then, to say that we may have a veteran that was exposed to ionizing radiation in some of these tests that subsequently developed leukemia, for example, and if he had not been exposed to that radiation he would not have developed it, whereas on the other hand, another veteran who was exposed to that may not have developed the leukemia?

Mr. JABLON. Exactly so.

Dr. ROWLAND. Mr. Sundquist?

Mr. SUNDQUIST. Thank you, Mr. Chairman.

Mr. Jablon, your experience in Japan relative to those who have been exposed to radiation at Hiroshima or Nagasaki, did that show a higher incidence of leukemia?

Mr. JABLON. Yes, sir.

Mr. SUNDQUIST. Than the general population?

Mr. JABLON. Yes, sir. Very much higher.

Mr. SUNDQUIST. Is it evident in the studies that the leukemia would occur as an aberration at an advanced age as opposed to the normal occurrence of leukemia?

Mr. JABLON. No, sir. There were many leukemias among children who were exposed, among young persons, and among old persons. The leukemias began to increase by 1948 or 1949. That is, within a couple of years after. And after about 1955, or thereabouts, the rate in the exposed survivors started to come down, very slowly, and it appears to us that the wave of leukemias is about finished, although I can't swear that there won't be another one or two or three radiation-induced cases.

Mr. SUNDQUIST. In your study, also, I want to come back to what I just commented, but I want to ask a question about thyroid exposure.

Mr. JABLON. Yes, sir.

Mr. SUNDQUIST. Apparently it doesn't take much exposure to have a thyroid cancer, a lower exposure there than perhaps in others.

Mr. JABLON. Thyroid is a particular problem. It is true, as you say, that the thyroid is apparently one of the more sensitive organs of the body and the induction rate for thyroid cancer per rad is higher than for most other things, probably excluding leukemia, of course.

But there's another problem about thyroid, and that is what we've been talking about, mostly, is external radiation. But thyroid glands tend to concentrate iodine and a particular isotope of iodine, a radioactive isotope, called I-131, is produced by atomic weapons, and if I-131 is taken into the body it will be concentrated in the thyroid and administer a very substantial dose to the thyroid gland before it decays away.

It's a very complicated thing because it depends upon the age of the individual as to what the concentration will be and so on and so on.

Mr. SUNDQUIST. If you were at the Veterans' Administration and your responsibilities were to allow or disallow claim benefits, how would you separate out those individuals, for instance, who have leukemia and how would you justify this person being allowed a benefit, this person not being allowed or this person who has a thyroid cancer being allowed and this other person being denied.

Mr. JABLON. To coin a phrase, Mr. Sundquist, I'm glad you asked me that question.

Mr. SUNDQUIST. Pardon me?

Mr. JABLON. I say I'm glad you asked me that question. Allusion was made earlier by Dr. Smith to the so-called radioepidemiological tables which were mandated in the orphan drug bill which was passed last December. Now, it happens that I'm connected with that undertaking and if I can propagandize you, sir, I think that the—it's not going to answer all of the questions, obviously, but the so-called radioepidemiological tables which the Department of Health and Human Services will produce will bring some kind of order to what is a very disorderly present situation.

I sympathize with the people in the VA who are the members of the Boards of Veterans' Appeals and the Compensation Board, because they have no guidance. You know that radiation can cause cancers of various kinds. You see a cancer of a particular kind. A person was radiated. How are you going to judge what the connection was? These tables will, as Dr. Smith told you, provide at least a guideline as to whether the probability was fairly high or was not fairly high.

For example, I can tell you that if you have a dose of 10 rads, which is pretty high, and a subsequent case of leukemia which occurred 5, 6, 7 years later, there is a very substantial chance that that leukemia was, in fact, induced by that radiation. If the radiation was 100 millirem, a tenth of a rem, a tenth of a rad, then the probability is very much smaller.

Of course, there's another issue. What were the doses? When you were questioning Dr. Caldwell, Mr. Edgar, I guess it was, asked about what was the cause of the increase? Well, there are several possibilities. Chance is always a possibility. Another possibility is that the film badge doses, which is what we know, are understating the doses that the men received.

Now, we know that they were understating them. That's for sure. Even with respect to the external gamma. The external gamma radiation was probably twice what the film badges were measuring. But in addition there is the possibility of neutron exposures which are not measured by film badges. That is a possibility. Also the possibility of ingestion or inhalation. Perhaps there was something peculiar about Smoky.

Now, we don't find increases in any of the persons who participated in any of the other tests that we've looked at. Unfortunately, Crossroads was not one of them and there was a lot of talk about Crossroads this morning.

Mr. SUNDQUIST. Well, I hate to interrupt you but I'm out of time. I'd just like to ask if what I'm summarizing is correct.

Mr. JABLON. Yes.

Mr. SUNDQUIST. In your opinion, then, it would be possible to take the dosages that are shown in the radiation exposure in general terms, and then take particular kinds of cancers and by giving the benefit of the doubt on those, the Veterans' Administration could virtually assure a high area of accuracy in benefits. Is that correct?

Mr. JABLON. I think you can do it more accurately that way than any other way.

Mr. SUNDQUIST. Thank you.

Dr. ROWLAND. Thank you, Mr. Sundquist.

Mr. Staggers?

Mr. STAGGERS. Thank you, Mr. Chairman. I guess mine would be a followup to Mr. Sundquist. It would appear that instead of taking radiation levels and making determinations that way, it would be better to look at the groups themselves. I'd assume that what you're saying is that [illegible] low radiation exposure could, in fact, cause a wide variety [illegible]ems such as the leukemia or whatever, and it may be mani[illegible]r 40 years down the road and so that looking at the stud[illegible]s is [illegible]ly a better way.

Is that what I'm gett[illegible]

Mr. JABLON. Yes, it'[illegible]cult. In fact, we don't know the complete story on rad[illegible]nogenesis yet. The longest, largest, best documented study [illegible]ave is the one of the survivors of Hiroshima and Nagasaki and we're now, only 35 years after, and, in fact, in the last report that came out of Hiroshima and Nagasaki, the cancer rates were going up. So, what the future holds, we can't tell. It's a very difficult, very difficult business.

Mr. STAGGERS. So, we actually shouldn't be looking at the amount of radiation exposure? It should be the results of what those people who were there, what actually happened to them?

Mr. JABLON. Yes. It seems to me on the basis of what we are finding for Smoky that we should make every attempt to solidify the dosimetry to the Smoky participants, which involves going beyond the film badges.

Mr. STAGGERS. OK. Thank you, Mr. Chairman.

Dr. ROWLAND. Thank you, Mr. Staggers.

Mr. Penny?

Mr. PENNY. No questions.

Dr. ROWLAND. Mr. Edgar?

Mr. **Edgar**. Thank you. I appreciated Mr. Sundquist's questioning and your response, particularly in terms of leukemia, because on page 10 of your testimony you list out those possibilities, and I think what you've indicated, at least in terms of the external badges, is that we know that the radiation levels in some of the tests were probably much higher than those badges, and I think that it would be safe to presume from your testimony and from other information that we have received that the instrumentation that was used could, in fact, have been defective. Would you agree with that, that the instruments that were used to measure in the test probably were not accurate?

Mr. **Jablon**. Well, I wasn't at the tests and so I can't testify. I will say that it's quite conceivable that there were inaccuracies. Any instrument is made to read over a certain range and if you get into a radiation field which exceeds the upper limit, you're just going to swamp it, and in fact, it's even conceivable that the needle might drop down to zero because of an overload on the instrument.

Mr. **Edgar**. I have a document here, and I don't mean to lay this out for you because you have not had access to it, but on the 21st of November 1946, there was a memo, technical anslysis section, from Dr. Herbert Scoville, to Captain G. M. Lyon. The subject was comments on results of investigation on the U.S.S. *Rockbridge* and this particular memo talks about the fact, down under point 3 it says any selected conversion factor might be in error by a factor of 5 or 10.

It goes on to talk about the, on point B on the second page, it talks about the difficulty of obtaining representative readings with the X-236 as, likewise causing errors in correlating these readings with two plutonium concentrations. These difficulties probably result from internal absorption of beta rays by the surfaces being measured, and inaccuracies in instruments itself when used to measure such low radiation intensities.

The documents that are available indicate that measurements on the instruments were, in fact, highly susceptible to inaccuracies, particularly in the early tests.

Mr. **Jablon**. I think that's especially true of the early tests.

And another point should be made too, and that is that we've learned, as we've gone along, from reading after action reports and accounts of what happened at tests, it seems plain to me that in the early 1950's, at least, the people just had no idea what they were dealing with.

Mr. **Edgar**. I really appreciate your answer because it seemed incredible to me that one of our earlier witnesses from the Defense Nuclear Agency would make a comment that we didn't really change very much the safety of the forces or troops over the years, that the safety in the beginning was about the same as it was in the end. I don't think that makes commonsense.

Mr. **Jablon**. Well, I wouldn't like to comment on what the General said.

Mr. **Edgar**. It wasn't the general specifically who said that. It was Dr.——

Mr. **Jablon**. Dr. Auton, yes.

Mr. **Edgar**. Yes.

Mr. **Jablon**. If I can volunteer one thing, I have heard the comment this morning about 5 rads being the safe level, and that's wrong. And I think we have to appreciate that's wrong. Five rads is an administrative number. It is a number which has been promulgated now by the Environmental Protection Agency as a limit for 1 year of occupational exposure. And there is nobody in the world that can prove that it's safe. I think you have to assume that 4 rads will be two-thirds as dangerous as 6 rads, and there is no cliff at 5 and you just fall off the risk level there.

Mr. **Edgar**. So that the No. 5 ought not to be used as a scientific measurement of safety?

Mr. **Jablon**. Exactly so.

Mr. **Edgar**. One other thing that troubled me. In some of the documents which will be released later, particularly on the test Baker, and I think all of us can appreciate that the different tests took place in different environments, in different areas. Land tests were different than at-sea tests. But in some of that documentation it says the following:

> All the nontarget ships on which the men lived and worked were moved into the radioactive lagoon, some as early as the day of the test itself and subsequently became contaminated.

Other summaries indicate that people got off of those ships, swam in the waters, breathed the air, participated very actively in the cleanup and in the further testing, within hours and, in fact, within days of the actual test.

It would seem to me that in your comments about thyroid and some of the other possible cancers that might result from overexposure, that those who bathed in the water or swam in the water may have had a different reaction because of ingestion of some of the contaminated substances as opposed to those who just perhaps stood and watched from a distance those explosions.

Wouldn't you believe that of the 42,000 that were in the test, test Baker, or the others that were in Smoky and others, that it would depend on where you were located and what your jobs were, and there would be great variations and gradations of exposure, given what your mission was in that particular test?

Mr. **Jablon**. Well, that's true, and I think perhaps one thing that could be done now, even now, that would be useful would be to try to establish some facts about possible internal emitters.

For example, plutonium has been mentioned. Now, plutonium was ingested and remains in the body and it ought to be possible even today to detect that. The iodine, of course, would have decayed away to nothing by this time. But some of the internal emitters are quite long-lived and will just sit there. Cesium, for example. And, say, putting people in a whole body counter, by——

Mr. **Edgar**. By putting people in a whole body counter?

Mr. **Jablon**. Yes, sir. You can do what's called "whole body counts". You put the whole man in a counter and can detect radiation coming from nuclides which were in the body.

Mr. **Edgar**. Do you know if the VA has any of those whole body counters?

Mr. JABLON. I don't know. Such counters are available and, if I'm not mistaken, Dr. Caldwell can tell you, I think he's gotten whole body counts.

Mr. EDGAR. The VA indicates by nodding their head that they do.

Mr. JABLON. OK.

Mr. EDGAR. They do have such things.

Mr. JABLON. Other things are possible. Allusion was made earlier this morning to chromosomal abnormalities. Now, one of the things that radiation does is it causes complex chromosomal aberrations, so-called exchange aberrations, rings, dicentrics, and the like. These are very long-lived and while I don't think you could use them very well as a measure of low doses, quite low doses, it has been suggested that such things can be used, measured, the proportion of chromosomal aberrations in peripheral leukocytes, can be used as an index to radiation exposure, and it might be, if one suspects some of the people maybe, say, at Smoky had very large doses, it might be possible, by doing chromosomal analyses on them, to see what one can find out. But it's there.

Mr. EDGAR. Thank you, Mr. Chairman.

Dr. ROWLAND. Thank you, Mr. Edgar. Thank you for focusing again on a point I was trying to make earlier about what may be etiological in one person may not be in another person, and to take the No. 5 and say that this is the danger point, really can't be done when you take hereditary factors and other variables into consideration.

Just in closing, these's one question that you've already touched on and I would ask Mr. Jablon, do you feel that an epidemiological study would be warranted in determining whether or not veterans who participated in atmospheric nuclear testing are suffering from an increased incidence of disease which might be attributable to ionizing radiation exposure?

Mr. JABLON. Well, I hate to be against motherhood, Mr. Chairman, but I don't think so. I don't think so. To do a study of health in living persons is a terribly expensive business, especially in this country where we don't have an index to where everybody is. Just finding people is a challenge.

And one thing we know, and it's shown even for leukemias. What have we got? Nine leukemias among 3,000 people. Some of the other health effects you would be looking for, even if they were increased, there aren't going to be that many cases. You're going to have to be examining thousands and thousands of men. You have to find them, you have to examine them, and the expectation of being able to conclude anything at the end of it, I think, is minimal.

I think it's reasonable to continue looking at mortality. Now, it's true that once a man has died you can't do very much to help him. But in terms of gaining knowledge as to whether there were risks, that at least can be done at an acceptable cost and you will get the information in time.

I am sorry to have to say that because at the Medical Followup Agency one of the things we do is studies of this kind but I think in this particular instance it just would not be a cost effective thing.

Dr. ROWLAND. It would not be cost effective.

Thank you very much, Mr. Jablon.

The Chair wishes to call now Mr. Weeks, Mr Guarisco, and Dr. Morgan.

STATEMENT OF A PANEL OF WITNESSES CONSISTING OF O. T. WEEKS, LEGISLATIVE DIRECTOR, NATIONAL ASSOCIATION OF ATOMIC VETERANS; ANTHONY GUARISCO, NATIONAL RESEARCH COORDINATOR; DR. KARL Z. MORGAN, FORMER DIRECTOR OF HEALTH PHYSICS LABORATORY, OAK RIDGE, TENN.; E. COOPER BROWN, GENERAL COUNSEL; GLENN ALCALAY, MEDICAL SCIENTIFIC ADVISER; AND DR. ARJUN MAKHIJANI

Dr. ROWLAND. These witness are from the National Association of Atomic Veterans, and you may proceed.

STATEMENT OF O. T. WEEKS

Mr. WEEKS. Mr. Chairman and members of the House Veterans' Affairs Committee, good morning. I am O. T. Weeks, legislative director of the National Association of Atomic Veterans. With me on behalf of NAAV this morning are Anthony Guarisco, NAAV research director, and Dr. Karl Morgan, head of the Nuclear Engineering Division of Georgia Tech, Institute of Technology.

Mr. John Smitherman, NAAV's president,[1] whom quite a few of you are familiar with, is not with us today because of health problems.

On behalf of their country atomic veterans were present at Trinity, the first atomic bomb test. We were at Hiroshima and Nagasaki, Japan. We were present for 17 years at the Nevada and Pacific Nuclear Testing sites.

We patriotically served our country and met the needs of national defense in a very critical period in history. We are now being condemned to illness and slow, painful death. Worse, we are witnessing within our children serious health and genetic problems of which there is presently no possibility of relief.

Recognition of the patriotic service atomic veterans rendered for their country, and relief for the consequences of that service, is why the National Association of Atomic Veterans is here today. We thank you for this opportunity to present our views.

Before I turn our presentation over to Dr. Morgan, I would like first to introduce several distinguished guests who would be available for any questions this committee might have. They are veterans who participated in nuclear tests conducted by other countries and who now suffer the same health problems American atomic veterans suffer. From Canada, Mr. Al Draper. From England, Mr. Tom Armstrong. And from Scotland, Mr. Phil Munn.

Finally, I request that the following documents that I have and reports be accepted for inclusion in the official records which will be prepared on this hearing. "Irradiation of Personnel During Operation Crossroads," by Dr. Arjun Makhijani and David Albright,[2] and prepared statements by Victor F. Tolley,[3] Robert Brack,[4] Mrs. Jean Ralph,[5] William Dolan,[6] Rocco Agostini,[7] Clyde Stair,[8] and Mr. Glenn Alcalay.[9]

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[1] The prepared statement of NAAV president Smitherman appears on p. 307.

[2] See p. 323.

And I also——

Mr. EDGAR. I ask unanimous consent that those documents be made part of the record.

Dr. ROWLAND. Without objection.

Mr. WEEKS. And also statements, testimony, from Dr. Sidney Cobb[10] and Donnell W. Boardman.[11]

At this time I would like to introduce Dr. Karl Morgan.

STATEMENT OF DR. KARL Z. MORGAN

Dr. MORGAN. I'd like to thank those responsible for making this hearing possible. I have participated in many congressional hearings and consider this an important part of our democratic system. I'm here at no compensation as a citizen of the United States that believes in fair treatment of our veterans. I speak in support of the atomic veterans who believe they received radiation damage at tests Able, Baker, and the Crossroads operation in 1946.

I have been working with ionizing radiation for more than 50 years. I was one of a group of five of the first health physicists at the University of Chicago at the beginning of the war, and today there are over 15,000 professional health physicists.

I was director of the health physics program at Oak Ridge National Laboratory for 29 years and I was chairman of both the national and international committees that set the standards for internal dose of all the radioactive materials, the levels we're using in the United States and throughout the world today.

So, I've had some acquaintance with this problem.

I made two visits to the Marshall Islands and took with me eight of my men from Oak Ridge National Laboratory to Bikini to conduct radiological monitoring following test Baker. I have with me here, your honor, a picture of myself with six of my men on one of the ships there. And I reported to Dr. Stafford Warren at these tests. Recently reports that he kept very meticulously on Crossroads were made generally available to the public and examined. These included a number of my own reports I made to Dr. Warren at the time of Crossroads.

These declassified papers have been reviewed by Dr. Arjun Makhijani and David Albright, whose summary has been submitted and accepted for the record.[1]

I was amazed to hear today that General Griffith and his counsel, were not familiar with these records, because surely they knew that Dr. Stafford Warren was in charge of the health effects and the survey work there. One would have thought that this would be the first place to go to find information about the Crossroads operation.

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[3] See p. 361.
[4] See p. 367.
[5] See p. 370.
[6] See p. 384.
[7] See p. 387.
[8] See p. 395.
[9] See p. 398.
[10] See p. 418.
[11] See p. 418.

It had been predicted, sir, that—and it's in the official record, by the way—that the underwater Baker test was fraught with many uncertainties and, in most respects, the levels of radioactive contamination and dose from alpha, beta, and gamma radiation exceeded our worst expectations, certainly my expectations.

This mighty 6,000-foot column of radioactive water reaching up into the sky from the Bikini Atoll, was the most awesome spectacle I have ever witnessed, and subsequent to this I have witnessed numerous atomic tests at the Nevada test site.

In 1946 members of the scientific community, including myself, were terribly naive. In fact, they were as naive as some of the generals and others in our military seem to be today. They were very naive about the risk of exposure to ionizing radiation.

We believed, I believed, there was a safe threshold level of radiation exposure of a tenth Roentgen per day, and so long as we stayed below this level we were safe and no harm resulted below this level. This tolerance level is seven times our MPC level today for the occupational worker and more than 7,000 times the 5 millirem per year level that's set by the Nuclear Regulatory Commission as acceptable for the nuclear powerplants that are staying within the "as low as reasonably achievable" guide that we go by today.

I took with me many instruments from Oakridge National Laboratory, along with my men. At Bikini we had great difficulty with some of these instruments, although they worked much better than those made available there by the service. My walkie-talkie, for example, an alpha survey meter, would not work properly except when it was contained inside U.S.S. *Haven*, an air-conditioned ship. But at least we had that to make measurements.

In fact, there was no field instrument that would work in measuring alpha contamination. And, of course, I had had long experience with geiger counters. I was the first person to use geiger counters in my part of the south. I built my own circuits, and was the first to use them with radiation protection work in the atomic energy business.

This failure to have meters to measure alpha activity meant that at this test we could only make poor guesses about the amount of plutonium, the most dangerous material known to man, which was released to the environment. I think each of us realizes that a speck too small to see, a fraction of a millionth of a gram of plutonium, can deliver more than a thousand rems dose, if contained inside the human body in proximity, say, to the active bone marrow.

I found no instrument at Bikini that was adequate for measuring beta dose, including the film badges that have already been discussed.

In fact, I made, sir, such a nuisance of myself with the various officers in insisting that we must have beta dosimetry that they threatened to throw me overboard, but they decided the simpler procedure was to give me 10 men and let me go out on these boats and ships and islands and make my own surveys. This I did. And I found that there were very high levels of beta activity.

In fact, the average level was ten times the gamma dose, and it was very common to find levels topside of these ships that were 100 times, and in fact, the highest I found, the dose from beta radiation was 600 times that of the gamma radiation.

Many of the men had high levels of contamination on their clothing and bodies. We even found where radioactive water from the ocean was used to wash off some of the tables and meat preparation equipment. Men were sleeping topside in the nude. Remember, the temperature was over 100 degrees fahrenheit at night, and some of the equipment on this deck was extremely hot.

Keep in mind, if you will, that over here, at 10 feet, there's an object that reads 100 times the average on this topside vessel. Maybe only 1 person in 10 has a meter. And yet we used this reading to determine what the average dose was and tried to construe some meaning from this.

On the deck of the U.S.S. *Haven*, for example, the equipment was brought in, photographic equipment, which you try to keep at very low dose, which was reading 21.6 rem per day. These are my own readings that are in the record. And the hands of one of the persons bringing this aboard, had 1.2 rem per day and his clothing was up to 12 rem per day. And these are readings that I had learned to take. I just indicated I have been in this business for over 50 years. So, they weren't readings taken by someone that was just learning the art, as was the case with most of the surveyors there.

I found that wood, rust, paint, cloth, hair, leather, oil, barnacles, algae, you name it, that they concentrate the alpha-emitting radionuclides. And for the physicists here I'd like to remind us that shortly after a nuclear detonation you have a preponderance of the high-energy beta emitters and some of them sufficient energy to penetrate into the skin more than a centimeter.

So, this presented a risk to the lens of the eye, to the gonads, and other organs.

Some of the samples were counted for alpha activity by myself and others and we found very high levels in some of the cases. For example, on the *New Yorker*, 2,500 per hundred square centimeters, and on the LST-133, we found 18,300 R per minute per hundred square centimeters, and so on.

Dr. Lyon, in his reports to Dr. Newell, indicated there were many infractions of the rules. For example, and I confirmed this from my own experience, going to most of the target ships as well as those that were occupied. For example, he mentioned in his report that men were boarding ships without authorization. They were living on contaminated target ships. And that they were removing equipment that was far too hot and even eating in these highly contaminated areas.

Many months later, when I took part in the atmospheric tests at Nevada, and I took part in many of them. I observed similar situations where you would find over here an instrument or a piece of the tower that was reading 100 or 1,000 times the ambient reading, and so a meter on just one person had little indication of the total risk.

In summary, I felt that the risk from internal intake was really severe. For example, I am now and have recently submitted reports on the feasibility of returning the natives to Bikini and to the other islands in the Northern Marshall group and I have indicated I think that it's very unsafe for them to return to these islands today because of the high levels of strontium and cesium. Mind you, if it's unsafe for them to return now, imagine what the condition was in the early period.

And so my time is up. I feel there's much to be said in defense of these fellows who at that time were young men in the service of our country who now have to fight even harder to prove that they were damaged from this operation. Thank you.

Dr. **Rowland**. Thank you, Dr. Morgan.

Mr. Guarisco, our time is short, as you see, and if you would summarize your testimony, we'd be most grateful.

STATEMENT OF ANTHONY GUARISCO

Mr. **Guarisco**. Yes, sir. I would at this time, considering the importance of what we're talking about here, the life-threatening effects of the personnel who were at these tests, I would respectfully ask for 5 more minutes, sir.

Dr. **Rowland**. Without objection.

Mr. **Guarisco**. Representative Montgomery, honorable committee members, I wish to cover three main points of concern. First and foremost, we are concerned that all bills that have been introduced over the last several years which could help atomic veterans and their genetically affected children have died in the Veterans' Affairs Committee.

As these bills have lain in the committee dying, so too have atomic veterans in need of legislation been dying. It is our sincere hope that this hearing today reflects a change in attitude by this committee and that help will be forthcoming.

Second, a special congressional investigation into the activities of the Defense Nuclear Agency would seem to be in order at this time. We have here approximately 1,000 pages of declassified documents found in the UCLA Public Library System, which leads us to believe that everything the DNA has ever told us about Operation Crossroads is a pile of garbage.

The documents disclose that veterans such as myself were knowingly placed at grave risk without being even warned of dangers. Not only were we placed in danger, but these records reveal that the medical-legal board was created at the time to insure that no subsequent legal actions could be successfully brought by those exposed while at the tests.

These documents directly conflict with the information that already has been published by the DNA about Crossroads. They especially conflict with what the DNA gives the VA as facts when veterans file claims. I have here pictures that will show that in Operation Redwing, 1956 and 1957, that shows men swimming in the water, shows men on radioactive vessels.

Moreover, the Defense Department has repeatedly told congressional committees that everything about the tests, which has been declassified, has been made available to the public. This is not true.

The declassified documents NAAV discovered were made available to the public through the family of the deceased Dr. Stafford Warren. These documents are nowhere else available. The Department of Defense obviously knew of these documents. They were declassifed in 1964 and NAAV was informed by the UCLA Library, in charge of the documents, that soon after the death of Dr. Warren, which was just last year, representatives of the Department of Defense or the Department of Energy or both went through the collection and apparently removed documents.

In light of these facts, and especially in light of General Griffith's statement this morning that the protective measures were as good later as they were in the early tests, we demand a special investigation of the DNA's test reconstruction activities and especially the location of all documents removed by the Defense Department from Dr. Warren's files.

It is essential that when such an investigation is initiated, that it be led by an individual outside and separate from any governmental influence, and that the principal investigator be someone of stature equivalent to an Archibald Cox. Atomic veterans will accept no less.

Our third concern is with the Veterans' Administration. The VA claims process is not working. We do not believe that it can ever be made to work under present circumstances. In the past we have asked for guidelines for radiation claims be adopted by the VA. We have asked for health studies. The VA has fought us at every turn.

At this point in time atomic veterans are convinced that the VA will never act in good faith on this issue. Consequently, we are asking for the passage of legislative, created presumption of service connection. Cancers and other degenerative diseases as well as genetic defects among our offspring, can be shown to have a scientifically based relationship to radiation exposure should be presumed to be service connected.

The burden of proof should be removed from the backs of the victims and placed squarely where it belongs. NAAV is fully aware of the about-to-be-completed cancer studies done by the National Academies of Science. However, the study will tell us very little about radiation injuries being suffered by the veterans.

What is desperately needed is a study that records the relative incidence of cancer and degenerative diseases among the atomic veterans. This is the only way we will ever discover the truth about the damage which has been caused.

We are appalled that the VA opposes these studies. The argument is that it could be too costly. To put this into proper perspective, the cost of the requested studies would be far less than one propeller on a Trident submarine. As a nation, has our sense of values deteriorated to the point where Trident propellers are more important than human lives?

Atomic veterans are also demanding health studies to investigate the genetic damages to their children. The VA argues that the genetic study of children would cause unnecessary fear and anxiety. This attitude characterizes the thoughtless cruelty of those within the VA. As parents who believe their children have been genetically affected, we want to make one thing very clear. Because the genetic studies have not been done and because the burning question in our minds has not been answered, there can be no greater fear and anxiety than that which is now shared by atomic veterans and their wives.

Atomic veterans are guilty of nothing more than having followed orders. Having done so, we now find ourselves being treated as simply radioactive byproducts of the Defense Department's nuclear weapons program. Are we to be buried as just so much more nuclear waste?

Atomic veterans are also demanding priority health care. Public Law 97-72 is not working. It will never work as long as the decision as to who gets treatment and who does not is left to the local VA physicians. Needed is hospital care and medical services on a priority level equivalent to that received by any veteran with a service-connected disability of 50 percent or more.

Finally, we ask this committee to initiate the proper steps to insure that all atomic veterans are located and warned of the potential exposure to radiation and the need for prompt medical diagnosis. I was in Crossroads myself. I have personally experienced severe health problems which doctors tell me may be related to high levels of radiation exposure.

After 37 years, there is really very little that you or anyone else can do for me. However, each of you here today has not only the obligation but the opportunity to insure that other atomic veterans are helped. Thank you very much.

And I thank you especially for the extra time that you allowed me, sir.

Dr. ROWLAND. Thank you very much for your testimony. I have no questions. Mr. Sundquist?

Mr. SUNDQUIST. I have no questions except to ask that we pass on the request to the Department of Defense to find out what happened to those records. I think that is important.

Dr. ROWLAND. Mr. Penny?

Mr. PENNY. No questions.

Dr. ROWLAND. Mr. Edgar?

Mr. EDGAR. Thank you, Mr. Chairman.

Mr. Chairman, I ask unanimous consent that this committee send a letter to the Department of Defense asking them to analyze the declassification of those documents in 1964-65 and asking whether or not there was a catalog of the documents that were declassified that could be compared to the documents that have been presented to this committee today.

Dr. ROWLAND. Thank you, Mr. Edgar.

Mr. EDGAR. Without objection, I ask that.

Dr. ROWLAND. Without objection, we'll do that.[1]

Mr. EDGAR. Thank you. I do have a couple of specific questions. Would you reiterate again where you got the Crossroads documents that were alleged to have been in a garage, by earlier witnesses today?

Mr. GUARISCO. Well, actually, sir, they were not in a garage. They were in the basement, underneath one of the main libraries, the biomedical library, on the campus of UCLA in Los Angeles.

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[1] See p. 107.

Mr. **Edgar**. So that they were not simply documents found in somebody's garage or basement, but they were in a library and that they had been public since 1965?

Mr. **Guarisco**. No. These documents were down in the basement in boxes but only accessible upon request. The documents are—the story, as it was related to me by the person who is in charge of the library, a Mr. Mink, advised me that Mr. Mink had passed away not too long before I was there in the library, which was the end of last year, I mean, Mr. Warren, and he advised me that his family wanted his collection to be published and put out for the public to be able to view.

He told me that when he went to get the material, which was in a standup type vault on the campus, that he found the doors of the safe thrown open and the materials scattered all over the floor. So, with some help, they—he and a couple of other people—picked up the documents and put them in boxes and took them back to a place where they kept them, and informed the Department of Defense and Department of Energy that they had these documents and if they wanted to look through them, to make sure that there was nothing in there that would be of national concern.

He said that they picked them up, they went through them, and when they were brought back, then he made them public.

Mr. **Edgar**. Let me ask Dr. Morgan a question.

Assuming, for the sake of argument, that there is a threshold tolerance level for radiation tolerance, and that industrial standards of the time, which are now much lower, represented no health risk, is it valid to apply industrial radiation standards to atmospheric nuclear weapons tests?

Dr. **Morgan**. No.

Mr. **Edgar**. Let me ask your opinion of some statements earlier about the value of the morbidity and mortality studies that are being made and their comparison with epidemiological studies. Do you think it would be of value to do a thorough epidemiological study at this point?

Dr. **Morgan**. Yes, I do. I think that there are a number of populations that deserve epidemiological study and careful evaluation. One of these would be those who participated in the South Pacific operations.

Mr. **Edgar**. Are you surprised with the disclosure of these documents on Crossroads, that the Department of Defense and the Defense Nuclear Agency have not focused more attention on these particular documents?

Dr. **Morgan**. This was very hard for me to appreciate that these documents existed all of these years, that it was well known by all of us that the late Dr. Stafford Warren was in charge of these measurements of dose and that he was the one responsible for collecting us to come out there with our equipment, and yet apparently those responsible for looking after the veterans hadn't even examined them and it was only this morning that they admit, that some of the witnesses admitted, it was the first time they had heard of them or seen them.

Mr. **Edgar**. I'd like to thank all of you for coming and also thank the veterans from Canada and Great Britain who came to the United States to observe these hearings and participate in your press conference yesterday, and also the support you receive from Australian veterans, recognizing that the international dimensions of the problem and the fact that veterans from other countries are asking some tough questions of their governments as well in terms of their exposure to radiation and their health impact.

So, I'd like to congratulate you on that.

Mr. Chairman, I'd like to ask one additional unanimous request. I'd like to ask unanimous request that we inquire of the VA as to the number and location of whole body scanners for the purpose of analyzing the whole question of nuclear radiation in the veterans that these—in the Veterans Administration.

Dr. **ROWLAND**. Without objection, Mr. Edgar.

So ordered.

Mr. **EDGAR**. Thank you.

[Subsequently, the Veterans' Administration furnished the following information:]

There is a whole body radiation monitoring instrument at each of the following Veterans Administration Medical Centers: Boston, MA; Hines, Chicago, IL; Iowa City, IA; West Los Angeles, CA.

There are 53 additional whole body radiation monitors nationwide, many of which are available to the VA because of affiliation relationships or close proximity of institutions (Attachment A).

The United States, with 57 monitoring instruments, had 35 percent of the worldwide total of 162 whole body radiation monitors (Attachment B).

ATTACHMENT A

INSTITUTIONS IN USA HAVING WHOLE BODY RADIATION MONITORS

Argonne National Laboratory, Argonne, Ill. University of California, Los Alamos Scientific Laboratory. Boston Veterans Administration Hospital, Radioisotope and Medical Service. University of Utah, College of Medicine. Brookhaven National Laboratory, Medical Department. Massachusetts Institute of Technology, Department of Physics. Walter Reed Army Institute of Research, Walter Reed Army Medical Center. Union Carbide Corporation, Nuclear Division. Battelle Memorial Institute, Pacific Northwest Laboratory.

University of Rochester, School of Medicine and Dentistry. University of California School of Medicine, Laboratory of Nuclear Medicine and Radiation Biology. Vanderbilt University and Hospital, Radioisotope Center. Veterans Administration Center, Los Angeles, California. New York University, Bellevue Medical Center. New York University Medical Center, Institute of Environmental Medicine. Oak Ridge National Laboratory, Health Physics Division. United States Atomic Energy Commission, Health Services Laboratory.

University of California, Donner Laboratory. E. I. Du Pont de Nemours & Co., Inc., Savannah River Plant. US Naval Radiological Defense Laboratory, San Francisco, California. United States Atomic Energy Commission, New York Operations Office. Purdue University, Bionucleonics Department. University of Chicago, Argonne Cancer Research Hospital. University of Arkansas, Medical Center. National Naval Medical Center, Bethesda 14 MD. State of Colorado Department of Public Health, Denver 20, Colorado.

Cornell University, New York State Veterinary College. University of California, School of Veterinary Medicine. Veterans Administration Hospital, Radioisotope Service, Iowa City, Iowa. Boston University School of Medicine, Radioisotope Service Section. National Institute of Health, Department of Nuclear Medicine, Bethesda, MD. Packard Instrument Company, Inc., Downers Grove, Ill. University of Illinois, College of Agriculture. University of Cincinnati, College of Medicine. University of Rochester, School of Medicine and Dentistry.

Oak Ridge Institute of Nuclear Studies, Medical Division. United States Public Health Service, Nuclear Medicine Unit, National Center for Radiological Health, Cincinnati, Ohio. University of Pittsburgh, Graduate School of Public Health. University of Missouri, College of Agriculture. USAF Radiological Health Laboratory, Dayton, Ohio. Southwestern Radiological Health Laboratory, Las Vegas, Nev. Dow Chemical Company, Golden, Colo. Mayo Clinic, Rochester, Minn. National Center for Radiological Health, Winchester, Mass. Helgeson Nuclear Services, Inc., Pleasanton, Calif.

Pan-American World Airways, Inc., Nuclear Rocket Development Station, Jackass Flats, Nev. Aerospace Medical Center, Brooks A.F.B., Tex. University of Miami, Miami, Fla. California Nuclear, Inc., Lafayette, Ind. Permian Corporation, Midland, Tex. US Testing Corporation, Hoboken, N.J. University of Florida, Gainesville, Fla. NASA Ames Research Center, Mottfield, Calif. Special Weapons Centers, Kirland Air Force Base, Albuquerque, N. Mex. Lawrence Radiation Laboratory, California. Aerospace Medical Division, Brooks A.F.B., San Antonio, Tex.

ATTACHMENT B

Worldwide distribution of whole body radiation monitors

Australia	3
Argentina	2
Austria	2
Belgium	3
Brazil	3
Canada	5
Congo (Dem. Rep.) Czechoslovak	1
Socialist Republic	1
Denmark	3
Finland	2
Greece	1
Germany (Fed. Rep.) (One of which is the U.S. Army Medical Research Unit in Europe)	14
Hungary	3
India	2
Israel	1
Italy	2
Japan	7
Jamaica	1
Netherlands	4
Norway	1
Poland	2
Romania	1
South Africa	2
Sweden	7
Spain	1
U.S.S.R	2
Switzerland	4
United Arab Republic	1
United Kingdom	15
U.S.A	57

Dr. ROWLAND. Gentlemen, thank you very much for your testimony.

Dr. MORGAN. Thank you, sir.

Dr. ROWLAND. Our next group is a panel composed of Mr. Magill, Mr. Passamaneck, Mr. Joeckel, Lieutenant Colonel Passamaneck.

STATEMENT OF A PANEL OF WITNESSES: JAMES N. MAGILL, SPECIAL ASSISTANT, NATIONAL LEGISLATIVE SERVICE, VETERANS OF FOREIGN WARS, LT. COL. DAVID J. PASSAMANECK, NATIONAL LEGISLATIVE DIRECTOR, AMVETS; CHARLES E. JOECKEL, JR., DEPUTY NATIONAL LEGISLATIVE DIRECTOR, DISABLED AMERICAN VETERANS

Dr. ROWLAND. Mr. Magill represents the National Legislative Service of Veterans of Foreign Wars, and Lieutenant Colonel Passamaneck is the National Legislative Director of AMVETS and Mr. Joeckel is the Deputy National Legislative Director of Disabled American Veterans.

Gentlemen? Mr. Magill?

STATEMENT OF JAMES N. MAGILL

Mr. MAGILL. Mr. Chairman, thank you for the opportunity to present the views of the Veterans of Foreign Wars with respect to radiation exposure. We have believed for a long time there is a relationship between certain medical conditions and exposure to radiation. There is, for example, as we have heard today, a much higher percentage of various cancers among those who were at test sites and what is being witnessed in the general population.

Because of this, we believe it is time for the Government to recognize this relationship and allow these veterans to be treated in VA facilities as service connected. Too much time has already passed and, for many, time is running out. In my prepared statement we have made several recommendations that we believe would lead to rectifying this problem.

This concludes my statement and I'll be happy to respond to any questions.

[The prepared statement of Mr. Magill appears on p. 426.]

Dr. ROWLAND. Thank you.

STATEMENT OF COLONEL PASSAMANECK

Colonel PASSAMANECK. Thank you, Mr. Chairman.

The approximately 200,000 members of the American Veterans of World War II, Korea, and Vietnam, appreciate this opportunity to present our views on the extremely important issue of adequate medical and compensatory care for veterans who have been exposed to radiation.

AMVETS is pleased to note that as of April 5, 1983, by VA circular, the medical service provided to irradiated veterans under Public Law 97-72 is now, or at least is supposed to be, coequal to that provided to herbicide-exposed Vietnam veterans. That entitlement applies to any medical condition not attributable to a definite cause other than herbicide or radiation exposure. We commend the Administrator of the Veterans' Administration, Mr. Harry Walters, for this prompt and compassionate response to the needs of our atomic veterans.

We, of course, recognize and appreciate the position taken by the previous witness relative to his contention that 97-72 is not working in that, of course, it depends for its effectiveness on the particular application at particular hospitals by particular medical personnel, and we fully recognize that there probably is some abuse, probably a considerable amount of abuse, in applying this 97-72 adequately.

We hope that that is cleared up in the process of actual operation.

Medical experience has demonstrated that the incubation periods for the disabilities which may result from radiation exposure are often much longer than the presumptive periods now provided in the code, the longest of which is 7 years for multiple sclerosis.

In order not to unjustly preclude deserving veterans from compensation, AMVETS advocates the enactment of an appropriate amendment to title 38 to establish, as a minimum, a rebuttable 25-year presumption of service connection for those disabilities which are epidemiologically connected with radiation exposure.

We will study H.R. 1914 in this regard, although we haven't had a chance to do so yet. It appears, from a first reading, to be a hopeful approach to the problem. We favor the enactment of sections 601 and 602 of Senate bill 11 in the 98th Congress and other similar legislation such as H.R. 1914, as badly needed efforts to clarify the state of scientific knowledge of radiation-induced disability.

We also recommend a timely comparative statistical survey of atomic veterans' medical problems by an agency independent of the VA and maybe even independent of the Government.

We oppose, however, any delay in the enactment of the presumption or the presumptive period, pending completion of epidemiological studies. AMVETS believes that sufficient medical knowledge now exists for the intelligent application of the presumption, at least in connection with certain recognized malignancies. Let's frame the law so as to give the benefit of the doubt, if any, to the veteran, while he and his family may yet derive some benefit from such legislation.

That concludes my testimony. Gentlemen, I'm ready for questions.

[The prepared statement of Colonel Passamaneck appears on p. 431.]

Dr. Rowland. Thank you. Mr. Joeckel?

STATEMENT OF CHARLES E. JOECKEL, JR.

Mr. Joeckel. Thank you, Mr. Chairman.

I have no prepared summary. I just wanted to discuss a little bit about what the committee's line of questioning has been. I noted that throughout the hearing you were referring to guidelines and at one time the Veterans' Administration had developed guidelines for the consideration of claims for service-connection of diseases related to radiation exposure.

That was contained in a program guide which was published in August of 1979. Since then, those guidelines have been challenged in the court and have been set aside for the moment. Recently, in October 1982 the Veterans' Administration republished the guidelines in accordance with the court's order and to this date no further action has been taken.

But I did want to point out that the guidelines followed hearings which were held in the Senate in June 1979. Prior to those hearings the Veterans' Administration, in 1978, allowed 18 cases related to radiation exposure. After the guidelines were in effect, the VA allowed 32 cases in 1979 and, again, after the guidelines were recinded, only 17 cases were allowed in 1980.

We think that there is a grave need to bring back the VA guidelines relating to claims filed by veterans exposed to radiation. I think it was, at least, an avenue, that veterans could pursue to have their claims allowed. It gave the Veterans' Administration much more flexibility in consideration of these kinds of cases.

I would at this time like to submit for the record a Board of Veterans Appeals decision; and I am submitting it for a number of reasons. Much has been made today about the recent findings regarding the Crossroads test. This particular claim of a veteran is one who participated in the Crossroads test; who later died of leukemia.

There is also a Navy reconstruction of the events relating to the crossroads test contained within the BVA decision. The following is stated within the Board of Veterans Appeals decision: "The chief difficulty in this case is that no significant exposure to radiation or circumstance for significant radiation exposure has been demonstrated."

"This nuclear test," referring to the Crossroads operation, "was one of the safest operations radiologically, in the atmospheric nuclear test program." At the end of the decision in which the denial occurs, the Veterans' Administration notes, "We are aware of the principle of resolving reasonable doubt in the appellant's favor and have reviewed the case with the principle in mind. But we find that the evidence of record is not such as to create reasonable doubt as to remote possibility."

For these reasons, Mr. Chairman, I'd like to submit this in connection with the information that was submitted on the Crossroads test, for the record.

Dr. **Rowland**. Without objection.

[The information appears on p. 323.]

Mr. **Joeckel**. The Veterans' Administration, to be quite fair about this particular case, had no choice in its denial. The whole claim is based on information received from the Defense Nuclear Agency which thus far, in connection with what the National Association of Atomic Veterans submitted, renders no other decision for the VA.

I would point out that the DAV supports the idea of an epidemiological study. We are very much interested in the statistical analysis which shows a relationship among veterans in particular tests, and the occurrence of different kinds of cancers. We would support such a study.

Finally, we are asking for a liberalization of the VA health care provisions for veterans who are exposed to radiation, so long as they have a malignancy which occurred within 10 years after discharge from service. That concludes my summarization. Thank you.

Dr. **Rowland**. Does the name of the veteran appear on the document which you have there?

Mr. **Joeckel**. Yes; it does.

Dr. **Rowland**. I'm advised by counsel that that name will have to be removed from this document before it can be made a part of the record.

Mr. **Joeckel**. Surely. Sure.

Dr. **Rowland**. I have no questions. Mr. Penny?

Mr. **Penny**. Mr. Chairman, this question will be directed to Mr. Magill, but the others are free to answer if they have any information that might be helpful. You indicated that of the 250,000 servicemen and women who may have been in or around the atmosphere of a nuclear test or a nuclear explosion there were some who were documentably close to the explosion when it occurred. In fact, in one instance you indicated six who were directly beneath an explosion that occurred above the ground and others who were 2,000 yards away from the explosion. Do we have any specific data on the incidence of cancers among those who were the closest?

Mr. **Magill**. Sir, at this particular time I have not been able to get even the names of those persons that were right underneath the blast, and so therefore I cannot supply that information. I would like to, if I could, and if I can, I will supply it for the record.[1]

Mr. **Penny**. Though it is understood that any exposure level could, in certain circumstances, contribute to a malignancy, the point made by Mr. Joeckel, I think, is a good one. We should at least try to establish some risk factor and be as speedy as possible in responding to the health care and compensation needs of those who can demonstrate that they were in a position to receive a much higher radiation dosage than the many others who were somewhat protected by distance.

Mr. **Joeckel**. Mr. Penny, some things are known. For example, hairy-cell leukemia is closely related to radiation exposure. Certain kinds of thyroid carcinomas, can be related to radiation exposure. Those lists of the various types of conditions were contained in the original VA guidelines and should be utilized.

Probably the relative risk factor, if we could find it, would be higher in those instances for those conditions than other disabilities. We're not saying that VA should give benefits for every type of disease that comes along. But for some things there is fairly well documented evidence.

Mr. **Penny**. It concerns me that we don't seem to have that evidence available right now. It's troublesome to note that there is an increased incidence of leukemia among people who are part of the Smoky group, but it would be even more alarming if we found out that increased incidence of leukemia was manifested among those who were 2,000 feet or less from the detonation. I think it's been a terrible oversight if, in fact, an analysis of where these individuals were in relation to the blast, is not a part of the record. It really ought to be.

Dr. **Rowland**. Mr. Edgar?

Mr. **Edgar**. Thank you, Mr. Chairman.

Mr. Joeckel, would you read once again for the committee the comment of the Board of Veterans Appeals that the Crossroads were the safest tests?

Mr. **Joeckel** [reading].

> The veteran appears to have been aboard the *U.S.S. Albemarle*. The vessel did participate in Operation Crossroads. This nuclear test operation was one of the safest operations radiologically in the atmospheric nuclear test program. As noted in the report from the Department of the Navy, 99 percent of all reported radiation exposures at Operation Crossroads ranged from zero to 0.5 rem gamma.

Mr. **Edgar**. I find it incredible that the Board of Veterans Appeals, as good as they are in most of their efforts and work, could make a flat statement like that about the safety or nonsafety of something like the Crossroads without having access to the data, and we heard from the Defense Nuclear Agency that they didn't know very much about the data that was made available today and, you know, to have that flat statement that it was one of the safest tests is amazing to me.

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[1] Not received at time of publication.

But I'm not going to dwell on that today. We'll look at that in the future.

Let me ask each of you, as organizations, we haven't talked today about identifying July 16, 1983 as Atomic Veterans Day, and I know the jurisdiction of that comes in another committee. It would be helpful to me to know what the opinion of the national veterans' organizations would be to identifying a specific day, the 38th anniversary of Trinity, as a day to focus attention on atomic veterans?

Colonel **PASSAMANECK**. Mr. Edgar. I would invite your attention to the last paragraph of my prepared written testimony which I did not read. It reads:

> Finally, Mr. Chairman, AMVETS is pleased to note the passage in the Senate on May 4, 1983 of Senate Joint Resolution 68, the resolution to honor atomic veterans on July 16, 1983. We also commend the House Judiciary Committee for favorably reporting the resolution on May 3, 1983.

And, of course, we hope that the full committee will see that the occasion is observed.

Mr. **JOECKEL**. Mr. Edgar, we're on record as supporting House Joint Resolution 210, which you sponsored.

Mr. **EDGAR**. Thank you.

Mr. **MAGILL**. We have documented in our written statement that we favor the passage of House Joint Resolution 210.

Mr. **EDGAR**. Thank you very much. No further questions.

Dr. **ROWLAND**. Thank you very much, Mr. Edgar.

With reference to the guidelines that you mentioned, I intend to pursue that area and see if we can have something done about that, and without objection, I have a statement which I wish to make part of the record.[1]

Dr. **ROWLAND**. I thank everyone very much for being here this morning and if there are no further comments, we stand adjourned.

[Whereupon, at 12:07 p.m., May 24, 1983, the hearing was recessed, subject to the call of the Chair.]

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[1] See p. 74.

APPENDIX

TESTIMONY OF
THE HONORABLE PAUL SIMON, MEMBER OF CONGRESS,
BEFORE THE
SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS
COMMITTEE ON VETERANS AFFAIRS
Tuesday, May 24, 1983

Mr. Chairman and members of the Committee, as a veteran myself I deeply appreciate the Committee's continuing concern about an issue which is of consuming interest to thousands of our fellow veterans, and to all who are interested in bringing an honorable end to the chapter of our history which ushered in the nuclear age.

Today, the issue of America's atomic veterans has been propelled to the fore by two major factors. First, the servicemen who participated in these tests are now at the point at which we would expect to see the greatest manifestation of cancer and other ill effects. Second, the question of low-level ionizing radiation is now on the cutting edge of medical science. What we know today shows that we were supremely incautious and somewhat naive about the dangers of low-level radiation during the above-ground atomic testing program. And today our atomic veterans problem is coming home to roost.

All of us would hope that much greater caution would be exercised under similar circumstances today, and I am sure that it would be. Consider, for a moment, the seemingly reckless way that service personnel were exposed to dangerous radiation during the testing period:

- GI's were sent aboard target fleet ships stationed off the test islands in the Pacific and directed to scrub the radiation from ships which were supposed to be under quarantine. According to one witness, the decks of those ships were still so "hot" that they would only permit short shifts for the scrubdown operation.

- Crews scoured these target ships for weeks, often living on them. They drank water from the lagoon distilled through frequently contaminated evaporators, and the lagoon water itself was found to be contaminated.
- Two of the target ships, the U.S.S. Nevada and the U.S.S. Salt Lake City, were boarded and were later torpedoed and sunk because of the residual radioactivity.
- Men in ships anchored in the target area swam in the lagoon, sometimes ate coconuts from Bikini and rarely if ever were informed of any danger in so doing.
- In the Nevada tests, troops were sometimes marched into the central detonation area soon after a blast, and many were not even issued radiation badges.
- One report allows that men were subject to "extremely hazardous respiratory conditions" in Operation Wigwam (1955).[1]

As one indication of the new evidence which is coming to light about the true exposure levels of these servicemen, I ask permission to include for the record a news account carried by the Washington Post on April 13, 1980, about once-classified records contained in the National Archives which disclose that low-level radiation outside the city limits of Nagasaki two months after the Nagasaki blast in 1945 -- at the time many U.S. troops were stationed there -- was about ten times what we now consider to be a safe level for the general population.

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[1] Wasserman, Harvey, et al, Killing Our Own: The Disaster of America's Experience with Atomic Radiation; Delacorte Press, N.Y., 1982

Thirty-seven years ago on July 1st, a 19-year-old sailor--a constituent of mine named Bob Farmer, now living in Steeleville, Illinois--was aboard a troop ship called the Cortland, stationed then in the Marshall Islands near an atoll named Bikini when a B-29 bomber dropped an atomic bomb on a collection of target ships 10 miles away. The shock waves from the 23-kiloton blast--hundreds of times more powerful than the bomb dropped on Hiroshima--rocked the Cortland. Later that month another test--an underwater atomic charge this time--threw battleships stationed in the test area into the air.

In between tests, Farmer and his shipmates were put aboard the target ships which were still afloat and told to scrub them down. They were ferried to the lagoon at Bikini where they frolicked in the contaminated sand and splashed about in the contaminated water with never a worry about radiation hazards.

According to a pictorial history of Operation Crossroads, published in 1946, "Intense and lasting radioactivity was produced in the water of the lagoon. The ships, drenched by tons of water thrown up by the explosion, became similarly contaminated."[2]

In the intervening years, Bob Farmer has had increasing heart trouble, and 15 years ago had to stop working as a truck driver. Today, he is easily out of breath and often has to summon family members to come rescue him when he is away from home and an irregular heart beat and a heart murmur bring on dizzy spells.

It fell to a private physician, not the VA, to discover a nodule on Bob Farmer's thyroid gland, with the VA staff running the same tests that the private doctor did. And more than a year after his thyroidectomy, Bob Farmer has yet to hear from the VA about any follow-up interest in his case.

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[2] Ingersoll, Bruce, "9Reasons He Can't Forget 2 Atomic Blasts"; Chicago Sun-Times, April 17, 1983, p.13

Then there are the children.

Genetic disorders are unknown on either side of the Farmer family tree. But they abound among the Farmer children. Nine children, nine genetic disorders. Here is a list:

- Robert Jr., 33 years old, was born with a lung deformity which has almost killed him twice through hemorrhaging.
- Dianna, 32, was born with skull irregularities which bring on headaches severe enough at time to drive her to hospital emergency rooms for relief.
- Victoria, 30, was born with abdominal and heart deformities.
- Patricia, 28, had an 8-pound non-malignant tumor removed 13 years ago.
- Steven, 22, was born with one knee joined to his torso and without a hip or thighbone. He did not get his first artificial leg until he was a first-grader.
- William, 21, was born with small cyst-like bumps all over his body just beneath the skin.
- Michael, 17, has an irregular heartbeat and is developing the same sort of bumps as William.
- Jeffrey, 15, finds an extra bone growing in his right leg.
- Janet, 14, suffers from a serious breathing problem.

Another atomic veteran, Joe Cavins from Ewing, Ill., took part in Operation Sandstone in 1948, and soon afterward lost all his hair and developed an incurable skin disease. Recently his back has been operated on for cancer.

A hall full of medical specialists could debate at length whether the ailments of Joe Cavins, Bob Farmer and Farmer's children are traceable directly to ionizing radiation from the atomic testing program. But, persuasive though the evidence appears to be, at the end of that debate there would not be an absolute "yes" or "no." One point on which medical opinion is unanimous is that no one-to-one corrolation is possible today in these questions. But in denying federal responsibility in the vast majority of atomic veterans disability cases, our government is certainly in the posture of taking the sternest approach to interpreting the evidence. That, together with the fact that the government itself was lax in its responsibility to safeguard our servicemen, understandably leaves a bitter taste in the mouths of many veterans. It is an unwarranted added dimension to these tragedies.

Bob Farmer is a patriotic, quiet, well-meaning man, and I believe him when he tells me that he senses disinterest bordering on callousness in the way VA has handled his case. The other day he told me, with sadness in his voice: "They don't want you there, and they discourage you so you won't come back."

I am concerned that the kind of experience which Bob Farmer has had is all too common among our atomic veterans.

This is a relatively new problem area, and my acquaintance with it over the last year has led me to the conclusion that additional legislative direction would be valuable in aiding our VA system in meeting the needs of atomic veterans. In my view, an ideal package of administrative and legislative solutions to these problems would include the following:

(1) Presumptive status for atomic veterans in determining eligibility for disability benefits. I don't believe the federal government should freely award benefits to atomic veterans without just cause, but I do see justice in freely granting them the benefit of the doubt.

(2) Standard procedures for deciding when atomic veterans should receive disability compensation.

(3) In-service training for VA personnel as new knowledge becomes available about the health consequences of low-level radiation.

(4) The commissioning by the Congress of an ongoing and definitive research effort aimed at determining the health effects of low-level ionizing radiation, to be conducted independently of the several federal agencies which have previously examined this issue, as a response to the yearning of the nation's veterans for completely credible data in this field, without fear of conflict of interest. This and other research efforts under the Committee's direction should also be broadened to include genetic and morbidity studies, as well as mortality analysis.

(5) The extension of VA medical and compensation benefits to the natural sons or daughters of atomic veterans, when there is reason to believe that their ailments are attributable to their parent's service-connected exposure to radiation.

I have introduced legislation intended to address some of these needs of ailing atomic veterans.

This issue involves unanswerable questions involving our knowledge of medicine, and any actions which Congress takes must be taken without perfect knowledge. But many of these veterans and their families need help today, and cannot wait for better medical understanding to arrive.

National Archives Yield Secret Radiation Data

By Walter Pincus
Washington Post Staff Writer

Two months after the atomic bomb was exploded over Nagasaki in 1945, two U.S. government research teams found low-level radiation in the Japanese city's outskirts that was about twice the level now considered safe for nuclear workers and over 10 times the radiation safety standard for the general population.

Reports of the two groups, scientists from the Manhattan Engineering District which built the bomb and a U.S. Navy medical research team, were completed in 1946 and are filed in the National Archives.

The once-secret reports are bound to increase the controversy that has developed over whether U.S. troops sent to Nagasaki and Hiroshima in 1945 absorbed enough radiation to cause cancers that appeared after 20 years or more.

About 100 veterans of the postwar cleanup of damages in the two cities filed claims with the Veterans Administration saying they now have maladies stemming from radiation exposure at Hiroshima and Nagasaki.

The scientists and engineers carried out 900 measurements in Nagasaki from Sept. 20 to Oct. 6, 1945. The bomb was dropped Aug. 9, 1945.

A fallout cloud passed over the Nishyama area, two miles from ground zero, and "fission products from the cloud left droplets of yellow-brown liquid," one report quoted Japanese eyewitnesses saying.

The highest levels measured by the Americans at Nichyama 40 to 70 days after the bomb were one milirem per hour or 8,760 milirem a year. At the time of the measurements, according to ther studies, the government-recognized "maximum tolerance dose" was considered to be four millirem per hour.

Today's permissible standards are far lower and different for individuals who work with radiation or live in an area with radiation exposure.

The nuclear-worker level is 3,000 milirem in three months or 5,000 milirem over a year.

The government standard for individuals not working with radioactive matter is 500 millirem a year.

The U.S. researchers estimated in 1945 that residents of the Nichyama area received a cumulative total of about 56 rem within 23 days after the fallout passed over.

By the time the U. S. scientists were taking measurements, around Sept. 25, they concluded the 24-millirem daily level was safe.

The levels at Hiroshima and Nagasaki, the two teams wrote in their reports, were "found to be far below the dose necessary to produce perceptible physiological effects."

To be on the safe side, the cleanup troops were rotated out, usually after a six-week tour, so none apparently approached even today's much lower safety level, according to the 1946 conclusions.

Norman Solomon, chief researcher for the Committee for Veterans of Hiroshima and Nagasaki, said Friday he had never heard of the studies filed in the archives.

Solomon's committee is one of several groups sponsoring a three-day national citizens' hearing for radiation victims that ends here today.

Defense Nuclear Agency officials also apparently are not aware of the 1946 studies.

In a Dec. 18, 1979, letter, White House aide Ellen L. Goldstein wrote that DNA said "the maximum dose which might have been received by any U.S. serviceman in either [Nagasaki or Hiroshima], in an absolutely worst case, is less than one rem."

PREPARED STATEMENT OF HON. J. ROY ROWLAND, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF GEORGIA

When the great scientist Madam Curie died of leukemia in 1934, few of her fellow scientists had any doubt at all that her death was caused by prolonged exposure to radiation.

Today, we have some 250,000 former servicemen who were exposed to ionizing radiation during above-ground tests of nuclear weapons between 1945 and 1962.

Although it has been accepted for many years that radiation exposure can cause grave health problems, especially in the reticulo endothelial system, some people now deny there is any solid evidence that these servicemen were harmed in the course of military duty.

It is a tragic fact that military personnel were sometimes turned loose on contaminated areas without adequate monitoring or measurement of radiation levels, and without adequate personal protection.

Evidence is growing that an increased incidence of leukemia, cancers, premature aging, atherosclerosis, and other genetic effects is found in atomic veterans and their children.

It is past time for the Government of the United States to acknowledge the problems of this group of individuals. At this time, the VA is turning down 99 percent of all claims of radiation-related diseases.

And yet there has been no genetic study to validate the VA position. Given this fact, I have to wonder why the VA is opposed to a study that could, once and for all, answer the question of whether or not atomic veterans have a legitimate claim to VA health care and compensation.

The House and the Senate have legislation which calls for the first epidemiological study of the effects of radiation exposure on former servicemen. And this is a first step.

Our Government, when calling a man to service, makes no guarantees for his safety and takes many risks with his life.

The Government, in turn, must accept responsibility for the outcome.

This can be the only fair exchange for a man's life. We must assume the burden of proof, or give the benefit of the doubt to those whose lives and those of their children have been irrevocably affected by circumstances beyond their control.

We owe no less to the atomic veterans than an acknowledgement of their exposure to excessive levels of radiation in the line of duty, and a promise that a study will be undertaken while there is still time to provide health care for those many disabled veterans.

NOT FOR PUBLICATION UNTIL
RELEASED BY THE COMMITTEE

STATEMENT OF
LTG HARRY A. GRIFFITH, USA
DIRECTOR, DEFENSE NUCLEAR AGENCY
BEFORE THE
SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS
COMMITTEE ON VETERANS' AFFAIRS
HOUSE OF REPRESENTATIVES

24 MAY 1983

Mr. Chairman and Members of the Committee:

I am pleased to be here today to provide the Committee with an overview of the efforts of the Department of Defense on behalf of the veterans who were possibly exposed to ionizing radiation as a result of their duties in the occupation forces of Japan or from their participation in U.S. atmospheric nuclear tests.

As you know, the Defense Nuclear Agency, as Executive Agent for the Department of Defense, has been documenting the DoD involvement in some 235 atmospheric nuclear tests as well as in the occupation of Hiroshima and Nagasaki. This effort, called the Nuclear Test Personnel Review (NTPR), has six principal tasks. The attached NTPR Fact Sheet discusses this program in detail. The major aspects of the program are as follows:

First, we are developing a comprehensive history of military participation in each nuclear test or event. The resulting library of 40 volumes is nearly complete, with 33 volumes published and the remaining 7 in the final stages for publication this year. These documents are distributed to more than 700 locations nationwide, including many public libraries. A list showing the distribution of test history documentation is attached to this statement. In addition, the documents are available for purchase through the National Technical Information Service. I brought one copy of each of these publications today for the use of the Committee staff.

Second, we are compiling a list of all Department of Defense personnel involved, to include the extent of their participation and their resultant radiation dose. We estimate that about 220,000 personnel were involved, of whom more than 206,000 have been identified by name. This is a lesser number than previously reported. The decrease resulted from elimination of duplicates and identification of some personnel who did not, in fact, attend the tests. We have also recovered radiation dose information on more than 139,000.

Third, we are providing calculations of radiation dose, both to correlate with badge readings and to substitute for dosimetry that is not available. Film badge doses are reconstructed from the specific activities of troop and naval units in the appropriate radiation environments. The methodology employs well-accepted scientific principles and has been reviewed by recognized international experts. Our confidence in the methodology is evidenced by the good correlation between the calculated doses and actual film badge data. We have also calculated, when appropriate, the dose due to neutron exposure and from inhaled or ingested radionuclides--doses that would not be recorded by film badges. To date, dose reconstructions have been performed for units involving more than 70,000 military personnel.

Fourth, we have a public contact program whereby interested persons can communicate with us to obtain information relating to their individual cases. To date, more than 49,000 contacts have been established through our public interface program.

Fifth, we have a program to notify any persons who received radiation doses greater than 5 rem. To date, we have identified over 1100 persons who received from 5 to 25 rem, and another 39 who received in excess of 25 rem. We have notified those persons for whom we have current addresses of their dose and that they are entitled to a free medical examination through the Veterans Administration.

Finally, we are declassifying many of the documents relating to atmospheric nuclear tests, including virtually all of the documents relating to DoD personnel exposures. To date, we have declassified over 800 documents, which are currently available for public purchase through the

National Technical Information Service. A list of these documents is attached.

The extensive research and analyses that we have conducted have disclosed that the exposure of the overwhelming majority of nuclear test participants was less than the current federal guidelines for occupational workers. We have given first priority to analyzing those tests involving the greatest potential for exposure, both external and internal. The average dose was about one half rem, which is one-tenth of the federal guideline for annual exposure of occupational workers. It is unlikely that subsequent research will alter these conclusions. With respect to Hiroshima/Nagasaki veterans, we performed a worst case analysis which demonstrated that the dose to any of these occupation forces could not have exceeded 1 rem. This analysis is extensively discussed in the attached Fact Sheet.

We are confident that we have a comprehensive program that considers all relevant information concerning the participation of DoD personnel in nuclear test operations, and for determining the radiation dose due to such participation.

I will now amplify the description of our extensive third task, the dose reconstruction effort. When film badge dosimetry is missing or is inadequate to characterize the total exposure, we determine the dose by relating the specific activities of each unit to the documented radiation environment in which they operated. This process was originally developed in 1978 for Task Force Warrior, which maneuvered after Shot Smoky. The results were compared with the actual film badge dosimetry for those troops. The excellent correlation of the two values gave us the confidence that external radiation doses could be determined for those cases where film badge information was not available or was not representative of the total exposure of the individual or unit. Additional cases have reinforced our confidence in the methodology, as has the post-analysis discovery of additional film badge readings and other relevant data. The entire dose reconstruction methodology has been published in the Federal Register and is discussed in every formal report in which it has been used. A copy of the Federal Register notice is attached. Also included in each report is the full rationale used to tailor the methodology to the case at hand. I should again emphasize that this dose reconstruction methodology has been extensively reviewed by the scientific community. Moreover, we have asked the National Academy to conduct a review of the overall methodology as published in the Federal Register.

As a part of the dose reconstruction effort, two additional aspects are considered, both concerning exposures not adequately recorded by film badges. The first is neutron radiation exposure. One of the earliest priorities in the dose reconstruction program was to determine all who were close enough to nuclear bursts to have received a neutron dose. This occurred only at the Nevada Test Site. In all cases where there was a significant potential for exposure to neutron radiation, the neutron doses were reconstructed.

The second additional aspect of dose reconstruction considers the dose due to inhaled or ingested radionuclides, commonly referred to as internal dose. The calculation of the dose from inhaled or ingested radioactivity involves the identification of radioisotopes entering the body. Inhalation or ingestion of radioactive material is calculated from airborne radioactive concentrations caused by the detonation itself or subsequent mechanical disturbances that loft radioactive material. Inhalation rates and durations of exposure are used to calculate the total material intake. Published conversion factors are then used to determine the radiation dose commitment, usually for a 50-year period, to specific organs of interest.

An important feature of the dose reconstruction methodology is a treatment of uncertainties. Both external and internal dose calculations involve uncertainties, but each is treated differently.

Every major unit dose reconstruction includes an uncertainty analysis that considers the accuracy and reliability of data used in the external dose calculations. When information is unavailable, uncertainties are estimated from knowledge of military practice, consistent with the documented aspects of the military activity. All of the variables relevant to personnel exposure are combined mathematically to arrive at the uncertainty in the external dose to the degree of confidence desired. The overall uncertainty, represented by upper and lower limits, accompanies the calculated external dose.

Internal dose calculations rarely require a formal uncertainty analysis. This is because the total uncertainty is usually dominated by the uncertainty in the particle lofting parameter. When an inexact parameter dominates the uncertainty, we have more confidence that the dose is less than a certain value than we do that it equals some other lesser value. Consequently, a high-sided value of that parameter is incorporated into the dose reconstruction. Technical, military, experimental, or common-sense constraints provide a reasonable upper limit for a parameter of this nature. For example, there are limits to how much dust can be breathed without choking or asphyxiation. For occupation troops in Hiroshima, one of the assumptions used was that the troops worked an eight-hour shift at ground zero for the period of occupation. This high-siding affords every benefit of doubt to the veteran. Even with such high-sided treatments, the internal dose commitments are usually very low. This is no coincidence. When the radiation environments warranted, enhanced safety precautions and monitoring were performed and documented. This reduced the uncertainties. Thus, when the doses are very small, the uncertainties are relatively large, but conversely, when the doses are more significant, the confidence in the calculations is higher because of the availability of supporting data.

As was mentioned earlier, dose reconstructions have been performed for military units involving more than 70,000 personnel. The reconstructions have included all the pertinent history, assumptions, methodology used, the significance of the uncertainties, and a comparison of the calculated dose with available film badge information. Copies of all such analyses have been furnished to the committee staff. In addition, more than 170 individual calculations have been performed in response to specific requests through the Veteran's Administration and in response to congressional inquiry or in support of litigation. Throughout the dose reconstruction program, we have generally prioritized the effort such that the cases with the potential for the highest dose were analyzed first. Thus, at this point we do not anticipate that subsequent analyses will result in doses of the same magnitude as have been already investigated. However, we will continue to apply the same degree of care to the remaining cases as we have applied to those already analyzed.

At our request, the National Academy of Sciences examined the feasibility of conducting an epidemiological study of the occupation forces at Hiroshima and Nagasaki and concluded that no study of this population could detect effects that were attributable to the doses received by these troops. The National Academy is also conducting a mortality study of over 50,000 veterans who participated in atmospheric nuclear tests. Dr. Jablon is discussing the study at this hearing.

In conclusion, we are confident that we have a successful NTPR program that will determine all relevant information concerning the participation of military personnel in nuclear operations. We shall continue to devote the necessary resources on a priority basis to complete the program and we will continue to provide all possible assistance to the veterans, the Veteran's Administration, and other interested agencies and organizations. I will be happy to address your questions.

Fact Sheet

dna
Defense Nuclear Agency
Public Affairs Office
Washington, D.C. 20305

10 January 1983

Subject: Nuclear Test Personnel Review (NTPR)

Background of NTPR Program.

Between 1945 and 1962, the Atomic Energy Commission (AEC) carried out some 235 atmospheric nuclear tests, principally in Nevada and the Pacific Ocean. An estimated 220,000 Department of Defense (DoD) personnel, military and civilian, were involved in this testing and many received low-level ionizing radiation exposures in the performance of various activities. Because the exposures generally were well within established radiation exposure limits, there was no reason to expect any increased health risk.

The first indication that former test participants might be experiencing adverse health effects possibly related to radiation exposure at the tests occurred in 1977. The Centers for Disease Control (CDC), as a result of its investigation of a leukemia case involving an individual who had participated in Shot SMOKY at the Nevada Test Site in 1957, became interested in the health status of all personnel who had been present at that shot. By late 1977, a DoD ad hoc committee, working together with CDC, had reconstructed a list of approximately 3,200 DoD personnel who were at or near the Nevada Test Site on the day of the SMOKY test and determined that some eight leukemia cases had occurred among them. CDC calculations indicated the expected incidence of leukemia would be three to four cases. CDC undertook an epidemiological study of these personnel and subsequently identified an additional leukemia case. It should be noted that the cause of the leukemias has not been determined to be related to radiation received at the test. In addition, no increased mortality from other forms of cancer has been observed in this group and the total number of deaths from all causes is essentially what would be normally expected.

Responding to this initial indication of a possible health problem, DoD, in December 1977, began a program of wide-ranging actions on behalf of the atmospheric nuclear test participants. The Defense Nuclear Agency (DNA) was appointed DoD's Executive Agent for this effort. The Nuclear Test Personnel Review (NTPR) program was established by DNA to carry out these responsibilities.

Scope of NTPR Program.

The Nuclear Test Personnel Review Program specific tasks are to:

- Compile a roster of the DoD personnel involved in the atmospheric nuclear tests.
- Develop a history of each atmospheric nuclear event that involved DoD personnel.
- Declassify all possible nuclear test related source documents which formerly bore a security classification.
- Provide estimates of atmospheric test radiation doses -- both as a check on film badge readings and as a substitute for them in those cases where badges were not worn or readings were not recorded or are not retrievable.
- Establish personal contact with as many test participants as possible.
- Identify those individuals who received a higher radiation dose than those doses recommended under current Federal guidelines for radiation workers, notify those individuals of their dose

60%

and offer them free medical examinations at Government hospitals.

- Sponsor, in conjunction with the Department of Energy (DOE), an independent mortality study by the National Academy of Sciences (NAS) of test participants selected by the NAS.

- Carry out a detailed research program, in conjunction with the on-going NTPR Program, to recover all data pertaining to possible radiation exposure of U.S postwar occupation troops at Hiroshima and Nagasaki, Japan. (This item was added to the original NTPR tasks in 1979 when concerns arose that veterans of the postwar occupation of those cities might be experiencing adverse health effects. Thus, since the Autumn of 1979, DNA has carried out a detailed research program to recover from records, historical documents, and interviews all possible data pertaining to the possible radiation exposure of those occupation troops.)

- Provide assistance to the veteran, the Veterans Administration (VA), and other organizations by doing individual research and by providing as complete data as possible on individual participation and radiation doses.

The overall NTPR effort is directed by the Defense Nuclear Agency, Washington, D.C. An NTPR team in each military service conducts detailed research into that service's participation in the atmospheric nuclear test program. A separate team at DNA's Field Command in Albuquerque, New Mexico has responsibility for research of records concerning DoD civilian employees and directs research into test participation by the former Armed Forces Special Weapons Project, a key test entity. In addition, DNA employs several contractors to provide specialized supporting services. The program has now been underway for five years, and about two more years will be required to complete the research. All phases of the NTPR program are being pursued on a high-priority basis, with adequate manpower (about 170 man-years per year) and funding (over $6 million per year). Its completion time is governed by the fact that necessary data are spread among hundreds of repositories and contained in tens or hundreds of thousands of documents.

NTPR Program Accomplishments

- First, the NTPR program has conducted most of the extensive research necessary to retrieve every possible bit of data about personnel participation and radiation exposure from records, archives, repositories, files, and other sources throughout the U.S. in order to piece together a coherent, personnel-oriented history of the atmospheric test program. The historical volumes (organized by series and shot, showing which organizations were there, what these organizations were doing, what radiological safety precautions were taken, what radiation dose levels were present, and other information) will be distributed to over 700 locations (including many public libraries) throughout the U.S. The order of publication of these historical reports is:

CONUS Operations	Actual/Projected Publication Date	Oceanic Operations	Actual/Projected Publication Date
PLUMBBOB (1957)	Oct 81	WIGWAM (1955)	Oct 81
TEAPOT (1955)	Mar 82	CASTLE (1954)	Apr 82
UPSHOT-KNOTHOLE (1953)	Apr 82	ARGUS (1958)	Dec 82
TUMBLER-SNAPPER (1952)	Apr 82	REDWING (1956)	Jan 83
RANGER (1951)	Apr 82	IVY (1952)	Feb 83
BUSTER-JANGLE (1951)	Dec 82	HARDTACK I (1958)	Apr 83
HARDTACK II (1958)	Jan 83	DOMINIC I (1962)	May 83
DOMINIC II (1962)	Feb 83	GREENHOUSE (1951)	Jun 83
TRINITY (1945)	Feb 83	SANDSTONE (1948)	Sep 83
PLOWSHARE (1962)	Mar 83	CROSSROADS (1946)	Nov 83

Participants who have written or called will be notified when volumes of concern to them have been published and informed of the location of libraries to which distribution has been made. This research/historical report production effort will continue until all atmospheric nuclear weapons tests have been documented and the historical volumes have been distributed.

Of the estimated 220,000 DoD participants in the tests, nearly 95 percent have been identified by name, and preliminary dose information has been recovered for about 134,000. The military services are reconstructing rosters from morning reports and ships' logs, searching medical records and other radiation dosimetry repositories, and identifying units' activities and movements. A product of this research will be listings of participants and their radiation dosimetry information for each series and shot; however, general release of these lists will not be made in order to protect personal data of individual participants.

- Second, more than 750 formerly classified documents containing information pertinent to the personnel aspects of atmospheric nuclear tests have been declassified. More than 670 of these documents have been catalogued for easy reference by former participants, the VA, and others and placed at the National Technical Information Service (NTIS) for ready public availability. NTIS is an agency of the Department of Commerce and offers these unclassified Department of Defense publications for sale along with other documents. The address and telephone number is: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, telephone 703-487-4650. If assistance is desired concerning the acquisition of material, most large public libraries are aware of NTIS and can assist in obtaining documents. The NTIS sales desk telephone number can also be called by any individual. If the exact report desired is not known, an NTIS subject analyst may be able to provide assistance. Moreover, most of the other unclassified documents have been placed at the Department of Energy Nevada Operations Office Coordination and Information Center, Las Vegas, Nevada.

- Third, the NTPR dose reconstruction program has proven to be of great value. It has been used to check the validity of film badge readings (with excellent correlation), to calculate doses for participating groups, and to reconstruct individual doses in specific cases (as in VA claims). As part of this effort, a separate analysis of possible exposures due to inhalation and ingestion of radioactive materials is being done. A later section of this fact sheet discusses dose levels to which participants in the atmospheric nuclear test program were exposed.

- Fourth, the NTPR program operates a toll-free telephone line (800-336-3068)* for test participants to report their involvement in the tests. Information provided by participants has significantly aided in the research and development of a permanent, computerized data base. To date, about 49,000 test participants have called or written DNA.

- Fifth, the individual notification and medical examination program for all individuals who received doses higher than 5 rem** is being carried out in segments, as described below:

  - In March 1979 a notification and medical examination program was initiated for all DoD test participants with cumulative doses from atmospheric testing in excess of 25 rem. The threshold of 25 rem was selected because it is the current recommended national guideline for one-time, planned exposures under emergency conditions. The National Council on Radiation Protection and Measurements evaluates the 25-rem threshold in the following terms in their NCRP Report No. 39 (p. 102):

> Since planned whole-body doses up to 25 rem are reasonably accepted for emergency conditions ..., it follows that accidental doses up to the same magnitude should not cause major concern. At higher levels and especially where the whole-body dose reaches 100 rem, medical observation and subsequent actions based primarily on medical opinion are the important aspects.

The NTPR program has identified a total of 39 DoD personnel in the over-25-rem group, with doses ranging from just over 25 rem to an estimated high of 98 rem. Most of these were exposed as a result of a wind shift at Shot BRAVO during Operation CASTLE at Bikini in 1954. Four of the 39 are known to be dead from causes not associated with radiation (i.e., trauma, heart attacks). Of the remaining 35 who were all notified, 18 desired physicals, 7 did not want examinations, and 10 have not responded. Of the 18 examinations which have been scheduled, we currently have received the results of thirteen. No adverse health effects associated with radiation exposure at the atmospheric nuclear tests were found during these examinations.

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* In Virginia, Hawaii, and Alaska call collect to (202) 274-9161.

** A rem is a unit of radiation dose equivalent and reflects the radiation energy deposited within the body tissue and its capability for causing an effect.)

- In May 1979, the notification and medical examination program was expanded to include the DESERT ROCK Volunteer Observers (Officer Volunteers). These 44 volunteers received gamma doses ranging from a few millirem to about 17 rem; however, they were closer to ground zero than any other participants at the time of detonation. The officer volunteers at shots NANCY, SIMON, BADGER, and APPLE II were also exposed to neutron radiation.

- In June 1979, after careful evaluation to ensure the over-25-rem program was functioning well, the notification and medical examination program was expanded to include all participants identified with annual doses in excess of 5 rem. This threshold was chosen both because 5 rem is the current Federal guideline for allowable annual dose to radiation workers and because it is the best single standard to represent permissible dose levels for most DoD personnel at the time of the tests. Notification of participants is based not only on film badge records but also on dose calculations or dose estimates, if these show a possible over-5-rem dose. It is estimated that about 1,100 DoD personnel will be involved.

- Throughout the course of the NTPR effort, the VA has had a program in effect whereby any eligible veteran test participant is given a free medical examination upon request.

- Sixth, the National Academy of Sciences is well into its third year of work to ascertain whether atmospheric test participants exhibit any adverse health effects which might be attributable to test participation. It is conducting a scientific follow-up study of over 50,000 DoD participants in Operations GREENHOUSE (1951), UPSHOT-KNOTHOLE (1953), CASTLE (1954), REDWING (1956) and PLUMBBOB (1957).

- Seventh, the Defense Nuclear Agency has completed research on the U.S. occupation of Hiroshima and Nagasaki. A detailed fact sheet on this has been produced and is being provided to all occupation personnel who have called or written to DNA. A detailed dose reconstruction--using numerous assumptions which would maximize dose--has also been completed. No areas of concern or significant doubt were identified, and the firm, well-substantiated conclusion is that the radiation doses received by members of the Hiroshima and Nagasaki occupation forces were negligible. DNA's research has disclosed no basis for concern by veterans of the Hiroshima and Nagasaki occupation forces over an increased risk of adverse health effects due to radiation during the occupation. In May 1981, the National Academy of Sciences convened a panel to review the occupation of Hiroshima and Nagasaki and to determine the feasibility and desirability of performing epidemiological studies of veterans who served in the occupation forces in Hiroshima or Nagasaki, Japan, immediately following the wartime bombing of those cities. The National Academy of Sciences panel concluded that:

(1) Scientifically sound studies of morbidity among military personnel who entered Hiroshima or Nagasaki soon after the bombings are impractical.

(2) Studies of mortality among these men, from a strictly scientific point of view, appear to carry inordinate cost in relation to the potential benefit.

(3) No study of the population in question could detect effects that would be predictable from existing knowledge of health hazards associated with radiation exposure.

(4) Even if an excess number of cases of multiple myeloma is present in this population of veterans, this cancer is unlikely to be attributable to ionizing radiation. (The NAS is currently investigating, for purposes of verification of diagnosis, the alleged cases of multiple myeloma).

- Finally, the Service NTPR teams have collected extensive basic information about each series and shot of the atmospheric test program in which that military service had any identified participants. They have also organized and trained their research teams in accessing individual service and medical records. They provide effective claims assistance to individual veterans and to the VA. The VA notifies DNA of all test participant veterans' claims and requests assistance in documenting participation and determining radiation dose, if any. The Service NTPR teams research all claims for the VA which have involvement in the atmospheric nuclear tests as the basis.

Dose Levels in the Atmospheric Test Program

Research to date indicates that most recorded doses to DoD personnel during the tests were quite low--averaging about half a rem. Of course, many participants received no dose at all, and only a very small percentage exceeded 5 rem per year, the current Federal guideline for allowable annual dose to radiation workers. The most basic source of dose data is the file maintained by the Reynolds Electrical and Engineering Company (REECo), a contractor of DoE (AEC), which is the official master repository of dose records for the atmospheric nuclear weapons tests. These REECo files, which contain the records of both DoD and AEC personnel, show the following:

REECo Film Badge Entries
(1945-1962)

Dose	Number of Entries	Percent of Entries
Zero	96,942	42%
One rem or less	204,952	88%
Three rem or less	225,765	97%
Five rem or less	230,984	99%
All	232,303	100%

NTPR Cross-checks on Exposure Levels

To cross-check the accuracy and completeness of the dose data held by REECo, and to ensure that it is representative of DoD participants, the NTPR program conducted numerous separate research efforts on exposures. Examples are:

- Research into historical documentation of numerous individual shots and test series shows dose results similar to the REECo averages. For example: In DESERT ROCK I (Nevada, 1951), none of the participants received over 5 rem; in BUSTER-JANGLE (Nevada, 1951), 0.2 percent received over 5 rem; in TUMBLER-SNAPPER (Nevada, 1952), 1.2 percent received over 4 rem; in TEAPOT (Nevada, 1955), 0.5 percent received over 3.9 rem.

- The Navy NTPR team extracted from REECo files the dose records of former Navy personnel who participated in oceanic testing. Of these individuals, 37 percent received zero exposure and less than one percent received more than 5 rem. In a separate research effort, the Navy conducted a reliability check of radiation dose records obtained from 7,900 individual medical records. Tabulation of the dose showed that less than one percent received more than 5 rem.

- Dose reconstruction was accomplished on Shot SMOKY to check on the accuracy of film badge readings (i.e., to see if test participants might have received larger radiation doses than their film badges recorded). Good correlation between actual film badge readings (0.575 rem average) and the calculated dosage (0.480 ± 0.135 rem) gives considerable confidence in film badge accuracy.

- Dose reconstructions have been done on other shots and series, and all support the data contained in the REECo files.

- Spot checks were made of film badge readings for members of units which maneuvered in proximity to each other and thus should have received comparable exposures. The results were indeed comparable.

- Intensive research and analyses have been carried out regarding possible neutron exposures, since neutrons would not be recorded on film badges. Dose reconstructions indicate that individuals with significant neutron exposure were officer volunteers. All cases where there was a potential for significant neutron exposure has been investigated in detail.

Based on cross-checks such as these, one can be confident that radiation dose levels shown by the REECo master file data (i.e., an average dose of about half a rem for all participants, and less than one percent with doses above the current allowable annual Federal standard) are reasonably representative of all DoD personnel. The identification and quantification of possible exposure due to inhalation and/or ingestion of radioactive materials has been accomplished for a number of events. Thus far, there have been no indications of significant exposure. This effort is continuing.

Health Effects of Ionizing Radiation

Numerous authorities, national and international, have addressed in detail the health risks caused by radiation doses and have recommended standards of acceptable doses for radiation workers. It has been established that adverse health effects can result from exposure to high levels of ionizing radiation (e.g., 100 rem or more). However, it is not known whether or not there are deleterious health effects from exposure to low levels of ionizing radiation (i.e., a few rem). For many years, medical scientists assumed there were no adverse effects from low exposure, i.e., that a "threshold" level of ionizing radiation existed, below which no adverse health effects would be caused. In the 1940's and 1950's, medical scientists gradually shifted to the present hypothesis--that there is no safe threshold, that even low levels carry some slight statistical risk, and that the degree of risk increases linearly with dose. This conclusion, however, is a hypothesis and is based on observations following high levels of exposure. No firm evidence exists to show that exposure to low levels of ionizing radiation would cause adverse health effects. Following are some examples of pertinent statements by medical and scientific authorities:

- The most direct data for the specific issue of atmospheric test participants comes from the Interagency Task Force on the Health Effects of Ionizing Radiation, conducted at White House direction and submitted to the President in August 1979 by the Secretary of Health, Education and Welfare. Its report states:

> For example, in a population of 10,000, one may normally expect 1,600 cases of fatal cancer; exposure of each of the 10,000 persons to one rem of low LET*, low rate, external, whole body radiation may be expected, under current risk estimates, to increase those deaths to roughly 1,601 (June 1979, p. 35).
>
> Thus, at current risk estimates, each individual has an overall likelihood of dying from cancer of about 16 percent, but the risk of dying from radiation-induced cancer is only about .01 percent for each rem of low-level exposure. Stated another way, 1,600 out of 10,000 persons will eventually die of cancer from various causes, but only one out of 10,000 may be expected to die of radiation-induced cancer following radiation exposure of one rem (June 1979, p. 5).
>
> Estimates vary, but the DoD, which is conducting a major research project to identify this test population, believes that about 250,000,** DoD personnel (the great majority of them military) participated in these tests. While the actual exposure levels are under study, the current collective dose estimate is 115,000 person-rems at the Nevada and Pacific test sites. The currently assumed dose-response relationship for cancer would indicate about 12 excess cancer deaths from this estimated radiation dose over the lifetimes of the 250,000 involved (June 1979, p. 63).

- The International Commission on Radiological Protection (ICRP), the most prestigious international group addressing radiation issues, makes the same risk estimate in their 1977 Recommendations of the International Commission on Radiological Protection, ICRP Publication 26, which states:

> For the purposes of radiation protection involving individuals, the Commission concludes that the mortality risk factor for radiation-induced cancers is about 10^{-2} Sv^{-1}, as an average for both sexes and all ages (January 17, 1977, p. 12). (Note: a sievert (Sv) equals 100 rem, thus the above statement puts the risk at one cancer death per 10,000 persons exposed to one rem.)

ICRP Report No. 26 also states, with regard to these risk estimates, that:

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*Linear Energy Transfer (LET) is the conventional expression for the rate of energy deposition measured along the track of an ionizing particle. Gamma rays and X-rays generate low-LET electron tracks. Alpha particles and neutrons generate high-LET tracks.

**Current estimate is about 220,000.

> The use of linear extrapolations, from the frequency of effects observed at high doses, may suffice to assess an upper limit of risk.... However, the more cautious such an assumption of linearity is, the more important it becomes to recognize that it may lead to an over estimate of the radiation risks.... Thus, in the choice of alternative practices, radiation risk estimates should be used only with great caution and with explicit recognition of the possibility that the actual risk at low doses may be lower than that implied by a deliberately cautious assumption of proportionality (p. 7).

- The United Nations Scientific Committee on the Effects of Atomic Radiation, in their 1977 UNSCEAR report, states:

> The average risk of inducing a fatal malignancy is thus taken as being in the region of 10^{-4} rad^{-1} ... (p. 6) (that is, one fatal cancer for every 10,000 individuals exposed to one rad).

This UNSCEAR report also states:

> It must be emphasized again, however, that such a value is derived essentially from mortalities induced at doses in excess of 100 rad. The value appropriate to the much lower dose levels involved in occupational exposure, and even more so in environmental exposures to radiation, may well be substantially less (p. 414).

- In 1980, the Committee on the Biological Effects of Ionizing Radiation (BEIR Committee) of the National Academy of Sciences issued The Effects on Populations of Exposure to Low Levels of Ionizing Radiation which updates their 1972 report. To illustrate risk calculations, the Committee considered two situations: a single exposure to 10 rads and a continuous, lifetime exposure of 1 rad per year. They found that the lifetime risk of cancer mortality ranges from 77 to 226 excess deaths per million per rad for the single exposure, and 67 to 182 excess deaths per million per rad for the continuous exposure. Thus for a single exposure to 10 rads, 770 to 2,260 excess cancer deaths are predicted per million people. The normal expectation of cancer deaths is from 160,000 to 170,000 per million. (pp. 191-192, 265) The 1980 BEIR report predicts a lower risk than their 1972 report. This is because they felt the linear response model used by the 1972 Committee to extrapolate from high exposure levels to low levels did not fit the epidemiological data from high dose exposures as well as the linear-quadratic dose-response model.

- The National Council on Radiation Protection and Measurements, taking cognizance of all available information on health risks, stated in their 1971 NCRP [illegible]ort No. 39, Basic Radiation Protection Criteria:

> The maximum permissible prospective dose equivalent for whole body irradiation from all occupational sources shall be 5 rem in any one year (p. 89).

NCRP Report No. 39 also states:

> In the interest of estimating effects in humans conservatively, it is not unreasonable to follow the assumption of a linear relationship between dose and effect in the low dose regions for which direct observational data are not available. It is generally agreed that such an assumption is conservative and would tend to give upper limits for any particular effect (p. 55).
>
> Experience with occupational exposure in the general neighborhood of presently acceptable limits over the last two or three decades has shown no identifiable injury ascribable to radiation (p. 50).

The NCRP reaffirms this 5 rem per year standard in their more recent (1975) Report No. 43. This report also states:

> The NCRP continues to hold the view that risk estimates for radiogenic cancers at low doses and low dose rates derived on the basis of linear (proportional) extrapolation from the rising portions of the dose-incidence curves at high doses and high dose rates, as described and discussed in subsequent sections of this report, cannot be expected to provide realistic estimates of the actual risks from low level, low LET radiations, and have such a high probability of over estimating the actual risk as to be of only marginal value, if any, for purposes of realistic risk-benefit evaluation (p. 2).

- The actual U.S. Federal radiation exposure standards were established by the President in 1960, based upon recommendations by the Federal Radiation Council. These standards are somewhat less stringent than the NCRP recommendations, in that they allow 3 rem per quarter, or 12 rem per year, until an accumulated dose equal to 5(N-18) is reached (where N is age in years). For example, a 26-year-old could, within today's Federal standards, receive doses of 12 rem per year for five years, thus accumulating 60 rem at the age of 30. Once the 5(N-18) limit is reached, allowable exposure is limited to 5 rem per year. The actual practice followed today however is to limit annual exposures to 5 rem.

- Nor is 5 rem per year a U.S.-only limit. The ICRP, an international body, also recommends an allowable exposure of 5 rem per year for occupational workers, and even condones 12 rem per year under infrequent conditions.

Summary

Based upon research to date, the average exposure of DoD participants in the atmospheric nuclear tests has been determined to be about one-tenth of the level that is generally agreed as an acceptable annual exposure for radiation workers; authorities widely agree in their assumption that the health risk from an exposure of half a rem is very low (approximately one fatal cancer per 20,000 individuals).

It should be noted that even today, 20-35 years after some 220,000 DoD personnel participated in the atmospheric test program, the only indication that there may be an increased health risk associated with test participation is CDC's identification of leukemia cases (now listed by CDC as nine) among participants whom CDC stated were present at the Nevada Test Site for Shot SMOKY, where the expected normal incidence in this group would be between three and four. (And, as stated earlier, CDC has not to date attributed this leukemia to exposure to ionizing radiation.)

The NTPR program is conducting a careful look into the history of the radiological safety aspects of the atmospheric nuclear weapons testing program and the development of historical documents to record the radiological exposures, if any, and to identify DoD personnel participation. The documents are now becoming available to the public at various libraries throughout the United States.

The careful and extensive study, so far, into the atmospheric nuclear test program indicates that overall the radiological safety precautions and safety measures taken, even in light of today's scientific knowledge of radiation effects, were adequate and there was only a very slight, if any, health risk to test participants.

This Fact Sheet Updates Nuclear Test Personnel Review (NTPR)
Fact Sheet, 1 March 1982

Facilities Receiving Nuclear Test Personnel Review Historical Volumes

3 January 1983

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Eastern Kentucky University
John Grant Crabbe Lib
Richmond, KY 40475

Hopkinsville Comm Col
North Drive
Hopkinsville, KY 42240

Kentucky Dept of Library & Archives
ATTN: Documents Section
State Library Services Div
P O Box 537
Frankfort, KY 40602

Kentucky, University of
ATTN: Director of Libraries (Regional)
Lexington, KY 40506

Louisville Free Pub Lib
4th & York Sts
Louisville, KY 40203

Louisville Univ Library
Belknap Campus
Louisville, KY 40208

Murray State Univ Lib
ATTN: Library
15th & Olive Sts
Murray, KY 42071

Louisiana

Veterans Administration—RO
ATTN: Director
701 Loyola Avenue
New Orleans, LA 70113

Isaac Delgado College
Moss Memorial Library
615 City Park Ave
New Orleans, LA 70119

Louisiana State University
ATTN: Director of Libraries (Regional)
Baton Rouge, LA 70803

McNeese State Univ
Frazer Memorial Library
Lake Charles, LA 70609

New Orleans Library University
ATTN: Govt Documents Div
Lake Front
New Orleans, LA 70122

New Orleans Public Lib
219 Loyola Ave
New Orleans, LA 70140

Nicholls State Univ Library
ATTN: Docs Div
Thibodaux, LA 70301

Northwestern State Univ
Watson Memorial Library
Natchitoches, LA 71457

Prescott Memorial Lib
Louisiana Tech Univ
Ruston, LA 71272

Richard W Norton Mem Lib
Louisiana College
Pineville, LA 71360

Shreve Memorial Library
P O Box 21523
Shreveport, LA 71120

Southern Univ In New Orleans Library
6400 Press Dr
New Orleans, LA 70126

Southwestern Lousiana Univ of
Louisiana Libraries
USL Box 4 0199
Lafayette, LA 70504

Howard Tilton Mem Libr
ATTN: Documents Dept
Tulane Univ
New Orleans, LA 70118

Maine

Veterans Administration—RO
ATTN: Director
Togus, ME 04330

Bangor Public Library
145 Harlow Street
Bangor, ME 04401

Bates College Library
Lewiston, ME 04240

Bowdoin College
Hawthorne Longfellow Lib
Brunswick, ME 04011

Maine Maritime Academy
Nutting Memorial Library
Castine, ME 04421

Maine, University of
Raymond H. Fogler Library
Orono, ME 04473

Mantor Library
ATTN: Director of Libraries
Univ of Maine at Farmington
41 High Street
Farmington, ME 04938

Portland Public Library
5 Monument Square
Portland, ME 04101

University of Maine at Orono
Bangor Community College Library
Bangor, Maine 04401

Maryland

Veterans Administration—RO
ATTN: Director
31 Hopkins Plaza
Federal Bldg
Baltimore, MD 21201

Enoch Pratt Free Library
ATTN: Documents Office
400 Cathedral Street
Baltimore, MD 21201

John Hopkins University
ATTN: Documents Library
Milton S Eisenhower Library
Baltimore, MD 21218

Maryland, University of
ATTN: McKeldin Lib Docs Div
College Park, MD 20740

Maryland, University of
Baltimore Co Library
5401 Wilkens Ave
Baltimore, MD 21228

Massachusetts

Veterans Administration—RO
ATTN: Director
J F K Federal Bldg
Government Center
Boston, MA 02203

Boston Public Library (Regional Dep)
ATTN: Documents Department
Boston, MA 02117

Brandeis University Lib
ATTN: Documents Section
415 South St
Boston, MA 02154

Curry College Library
1071 Blue Hill Ave
Milton, MA 02186

Harvard College Library
ATTN: Director of Libraries
Cambridge, MA 02138

Massachusetts, Univ of
ATTN: Government Docs College
Goddell Library
Amherst, MA 01002

MIT Libraries
Serials & Journals 14E 210
Boston, MA 02139

Northeastern University
ATTN: Dodge Library
360 Huntington Ave
Boston, MA 02115

Southeastern Massachusetts Univ Lib
ATTN: Documents Sec
P O Box 6
New Bedford, MA 02747

Springfield City Library
ATTN: Documents Section
220 State Street
Springfield, MA 01103

State Lib of Mass
State House
Boston, MA 02133

Tufts University Library
ATTN: Documents Dept
Medford, MA 02155

William College Library
Williamstown, MA 01267

Worcester Public Library
Salem Square
Worcester, MA 01608

Michigan

Veterans Administration—RO
ATTN: Director
Patrick V. McNamara Federal Bldg
477 Michigan Avenue
Detroit, MI 48226

Calvin College Library
3207 Burton St SE
Grand Rapids, MI 49506

Central Michigan University
ATTN: Library Documents Section
Mt Pleasant, MI 48859

Delta College Library
Mackinaw and Kuch Rds
University Center, MI 48710

Detroit Public Library
5201 Woodward Ave
Detroit, MI 48202

Eastern Michigan University Lib
Ypsilanti, MI 48197

Grand Rapids Public Library
ATTN: Director of Libraries
60 Library Plaza NE
Grand Rapids, MI 49503

Henry Ford Comm College Lib
5101 Evergreen Rd
Dearborn, MI 48128

Hoyt Public Library
505 James Street
Saginaw, MI 48605

Kalamazoo Public Library
315 South Rose Street
Kalamazoo, MI 49007

Michigan State Library
Govt Ctr Lib Law Bldg
P O Box 30007
733 E Mich Ave
Lansing, MI 48909

Michigan State University Library
E Lansing, MI 48824

Michigan Tech University
ATTN: Library Documents Dept
Houghton, MI 49931

Michigan, University of
ATTN: Acq Sec Documents Unit
Harlan Hatcher Library
Ann Arbor, MI 48109

Northern Michigan Univ
ATTN: Documents
Olson Library
Marquette, MI 49855

Northwestern Michigan College
Mark Osterlin Library
1701 East Front Street
Traverse City, MI 49684

Oakland Comm College
Martin L King Lrng Res
27055 Orchard Lake Rd
Farmington, MI 48024

Olivet College Library
Olivet, MI 49076

State Historical Soc Lib
ATTN: Docs Serials Section
816 State St
Madison, MI 53706

Traverse City Public Library
322 Sixth St
Traverse City, MI 49684

Wayne State Univ Library
G Flint Purdy Library
5244 Gullen Mall
Detroit, MI 48202

Wayne State University Law Library
ATTN: Documents Dept
468 W Ferry St
Detroit, MI 48202

Minnesota

Veterans Administration—RO
ATTN: Director
Fort Snelling Federal Bldg
P O Box 1820
St Paul, MN 55111

Anoka County Library
1100 90th Ave NE
Blaine, MN 55434

Bemidji State College
ATTN: Library
Bemidji, MN 56601

Carleton College Library
Northfield, MN 55057

Duluth Public Library
ATTN: Documents Section
520 W Superior Street
Duluth, MN 55802

Gustavus Adolphus College
ATTN: Library
Saint Peter, MN 56082

Hennepin County Libraries
ATTN: Government Documents
70th at York Avenue South
Minneapolis, MN 55435

Mankato State College
ATTN: Govt Publications
Mankato, MN 56001

Minneapolis Public Lib
300 Nicollet Mall
Minneapolis, MN 55401

Minnesota, University of
ATTN: Director of Libraries (Regional)
2030 University Avenue SE
Minneapolis, MN 55414

Moorhead State College
ATTN: Library
DS 306
Moorhead, MN 56560

St Paul Public Library
Saint Paul, MN 55102

Mississippi

Veterans Administration—RO
ATTN: Director
1500 E Woodrow Wilson Avenue
Jackson, MS 39216

Delta State University
W B Roberts Library
Cleveland, MS 38732

Mississippi State University
Mitchell Memorial Library
Acquisition Dept
State College, MS 39762

Mississippi, University of
ATTN: Director of Libraries
P O Box 162
University, MS 38677

Southern Mississippi, Univ of
ATTN: Library
Southern Station Box 5053
Hattiesburg, MS 39401

Missouri
Veterans Administration—RO
ATTN: Director
Federal Building
1520 Market Street, Rm 4800
St Louis, MO 63103

Kansas City Public Library
ATTN: Documents Div
311 E 12th Street
Kansas City, MO 64106

Missouri, University of
ATTN: Government Documents Library
Columbia, MO 65201

Missouri Univ at Kansas City Gen
5100 Rockhill Rd
Kansas City, MO 64110

Northeast Missouri State University
Pickler Memorial Library
Kirksville, MO 63501

Southeast Missouri State University
Kent Library
Cape Girardeau, MO 63701

Southwest Missouri State College
ATTN: Library
901 South National
Springfield, MO 65802

St Joseph Public Library
10th & Felix Sts
Saint Joseph, MO 64501

St Louis Public Library
1301 Olive Street
Saint Louis, MO 63103

Washington, University of
ATTN: Documents Div
John M Olin Library
660 Millbrook Blvd
Saint Louis, MO 63130

Central Missouri State College
ATTN: Government Documents
Ward Edwards Library
Warrensburg, MO 64093

Montana
Veterans Administration—RO
ATTN: Director
Fort Harrison, MT 59636

Eastern Montana College Library
ATTN: Documents Department
1500 North 30th Street
Billings, MT 59101

Montana State Library
East Lyndale Avenue
Helena, MT 59601

Montana State University Lib
Bozeman, MT 59717

Montana, University of
ATTN: Director of Libraries (Regional)
Missoula, MT 59812

Northern Montana College Library
Havre, MT 59501

Nebraska
Veterans Administration—RO
ATTN: Director
Federal Building
100 Centennial Mall North
Lincoln, NE 68505

Calvin T Ryan Library
ATTN: Government Documents Dept
Kearney State College
Kearney, NE 68847

Nebraska Library Comm
Nebraska Pub Clearinghouse
1420 P St
Lincoln, NE 68508

Nebraska Western College Library
1601 E 27th NE
Scottsbluff, Nebraska 69361

Nebraska, University of
ATTN: Director of Libraries (Regional)
Lincoln, NE 68588

Omaha Pub Lib Clark Branch
Business Scientific Tech Dept
215 South 15th St
Omaha, NE 68102

Omah, Univ oScottsbluff Public Library
1809 Third Avenue
Scottsbluff, NE 69361

Nevada
Veterans Administration—RO
ATTN: Director
245 E Liberty Street
Reno, NV 89520

Nevada Library, Univ of
ATTN: Government Publ Dept
Reno, NV 89557

Nevada, University at Las Vegas
ATTN: Director of Libraries
James R. Dickinson Library
4505 Maryland Parkway
Las Vegas, NV 89154

Elko County Library
720 Court Street
Elko, NV 89801

New Hampshire
Veterans Administration—RO
ATTN: Director
Federal Building
275 Chestnut Street
Manchester, NH 03103

Dartmouth College
Baker Library
Hanover, NH 03755

Manchester City Library
405 Pine Street
Manchester, NH 03104

New Hampshire University Lib
Durham, NH 03824

New Jersey
Veterans Administration—RO
ATTN: Director
20 Washington Place
Newark, NJ 07102

Drew University
Rose Memorial Library
36 Madison Ave
Madison, NJ 07940

East Orange Public Lib
U S Government Depository
21 South Arlington Ave
East Orange, NJ 07018

Eastern Branch
Monmouth County Library
NJ Highway 35
Red Bank, NJ 07701

Fairleigh Dickinson Univ
ATTN: Depository Dept
Messler Library
Rutherford, NJ 07070

Free Pub Lib of Elizabeth
11 S Broad Street
Elizabeth, NJ 07202

Glassboro State College
Savitz Learning Res Ctr
Glassboro, NJ 08028

Jersey City State College
F A Irwin Lib Perdcls Doc Sec
2039 Kennedy Blvd
Jersey City, NJ 07305

Johnson Free Public Lib
275 Moore Street
Hackensack, NJ 07601

Newark Public Library
5 Washington St
Newark, NJ 07101

Ocean County College
Learning Resources Ctr
College Dr
Toms River, NJ 08073

Passaic Public Library
195 Gregory Ave
Passaic, NJ 07055

Phillipsburg Free Public Library
200 Frost Avenue
Phillipsburg, NJ 08865

Plainfield Public Library
Eight Street, Park Ave
Plainfield, NJ 07060

Princeton University Library
ATTN: Documents Division
Princeton, NJ 08544

Rutgers Camden Library Univ
300 North 4th Street
Camden, NJ 08102

Rutgers, The State University
John Cotton Dana
185 University Ave
Newark, NJ 07102

Stockton State College Library
Pomona, NJ 08240

Trenton Free Public Library
120 Academy Street
Trenton, NJ 08608

New Mexico

Veterans Administration—RO
ATTN: Director
Dennis Chavez Federal Bldg
U S. Courthouse
500 Gold Avenue SW
Albuquerque, NM 87102

Eastern New Mexico Univ
Golden Library
Portales, NM 88130

Los Alamos National Scientific Lab
ATTN: Library
Mail Station 5000
P O Box 1663
Los Alamos, NM 87545

New Mexico State Library
P O Box 1629
Santa Fe, NM 87501

New Mexico State University
ATTN: Lib Documents Div
Box 3475
Las Cruces, NM 88003

New Mexico, University of
ATTN: Director of Libraries (Regional)
Zimmerman Library
Albuquerque, NM 87131

New York

Veterans Administration—RO
ATTN: Director
Federal Building
111 W Huron
Buffalo, NY 14202

Veterans Administration—RO
ATTN: Director
252 Seventh Avenue
New York, NY 10001

Albany Public Library
161 Washington Avenue
Albany, New York 12210

B Davis Schwartz Mem Lib
C W Post Ctr, Long Island Univ
Greenvale, NY 11548

Benjamin F Feinberg Library
ATTN: Government Documents
State University College
Plattsburgh, NY 12901

Brooklyn College
ATTN: Documents Division
Bedford Ave & Ave H
Brooklyn, NY 11210

Buffalo & Erie Co Pub Lib
Subscription Div
Lafayette Square
Buffalo, NY 14203

Colgate Univ Library
ATTN: Reference Library
Hamilton, NY 13346

Columbia University Library
ATTN: Documents Service Center
420 W 118th St, Rm 327
New York, NY 10027

Cornell University Lib
Serial Dept
Ithaca, NY 14853

East Islip Public Library
381 East Main Street
East Islip, NY 11730

Elmira College
Gannett Tripp Learning Ctr
Elmira, NY 14901

Herbert H Lehman College
ATTN: Library Documents Division
Bedford Park Blvd W
Bronx, NY 10468

Hofstra Univ Library
ATTN: Documents Dept
Hempstead, NY 11550

Horrmann Library
Wagner College
Grymes Hill
Staten Island, NY 10301

Nassau Library System
900 Jerusalem Avenue
Uniondale, NY 11553

New York Public Library
Lenox Branch
476 5th Ave
New York, NY 10018

New York State Library
ATTN: Doc Control Cultural Ed Ctr
8th Floor
Cultural Education Center
Empire State Plaza
Albany, NY 12230

New York State, University of
ATTN: Docs Librarian
Milne Library
Geneseo, NY 14454

New York at Stony Brook, Univ of
ATTN: Main Lib Documents Section
Stony Brook, NY 11790

New York Col at Cortland, State Univ of
Memorial Library
Cortland, NY 13045

New York State, Univ of
ATTN: Library Documents Sec
Vestal Parkway East
Binghamton , NY 13901

New York State, Univ of
College at Purchase
Purchase, NY 10577

New York, State University of
ATTN: Documents Center
Penfield Library
Oswego, NY 13126

New York, State University of
ATTN: Documents Dept
Lockwood Memorial Library
Buffalo, NY 14260

New York, State University of
Drake Memorial Library
Brockport, NY 14420

New York University Library
ATTN: Documents Dept
7th Floor
70 Washington Sq So
New York, NY 10012

Niagara Falls Pub Lib
1425 Main St
Niagara Falls, NY 14305

Onondaga County Public Library
ATTN: Government Documents Section
335 Montgomery Street
Syracuse, NY 13202

Pratt Institute Library
Brooklyn, NY 11205

Rochester Library, University of
ATTN: Documents Section
River Campus Station
Rochester, NY 14617

Skidmore College
Saratoga Springs, NY 12866

St Bonaventure University
Friedsam Mem Library
St Bonaventure, NY 14778

St Lawrence University
Owen D Young Library
Canton, NY 13617

Syracuse University Library
ATTN: Documents Div
Ernest S Bird Library
222 Waverly Ave
Syracuse, NY 13210

University Libraries
ATTN: Director of Libraries
Suny/Buffalo
432 Capen Hall
Buffalo, NY 14623

Yeshiva University
Pollack Library
500 West 185th Street
New York, NY 10033

North Carolina

Veterans Administration—RO
ATTN: Director
Federal Building
251 N Main Street
Winston Salem, NC 27102

Appalachian State University
ATTN: Library Documents
Boone, NC 28607

Charlotte & Mechlenburg Count Pub Lib
ATTN: E Correll
310 North Tyron Street
Charlotte, NC 28202

Davidson College
Hugh A & J Grey Mem Library
Davidson, NC 28036

Duke University
ATTN: Public Docs Dept
Wm R Perkins Library
Durham, NC 27706

East Carolina University
ATTN: Library Docs Dept
Greenville, NC 27834

Elon College Library
Box 187
Elon College, NC 27244

Gardner-Webb College
ATTN: Documents Librarian
POB 836
Boiling Springs, NC 28017

New Hanover County Public Library
409 Market St
Wilmington, NC 28401

North Carolina Agri & Tech State Univ
F D Bluford Library
Greensboro, NC 27411

North Carolina at Charlotte, Univ of
ATTN: Atkins Library Documents Dept
UNCC Station
Charlotte, NC 28223

North Carolina at Greensboro Library, Univ of
Walter Clinton Jackson
Greensboro, NC 27412

North Carolina at Wilmington, Univ of
William M Randall Lib
P O Box 3725
Wilmington, NC 28421

North Carolina Central University
James E Shepard Mem Library
Durham, NC 27727

North Carolina State University
D H Hill Library
P O Box 5007
Raleigh, NC 27607

North Carolina at Chapel Hill, University of
ATTN: BA SS Division Documents
Chapel Hill, NC 27514

Western Carolina University
Hunter Library
Cullowhee, NC 28723

North Dakota

Veterans Administration—RO
ATTN: Director
21st Avenue & Elm Street
Fargo, ND 58102

Dickinson State College
Stoxen Library
Dickinson, ND 58601

Minot State College
Memorial Library
Minot, ND 58701

North Dakota State University
ATTN: Docs Librarian
Fed Documents Office
Fargo, ND 58105

North Dakota, University of
Chester Fritz Library
Grand Forks, ND 58201

Ohio

Veterans Administration—RO
ATTN: Director
Anthony J Celebrezze Federal Bldg
1240 E 9th Street
Cleveland, OH 44199

Akron Public Library
55 South Main St
Akron, OH 44326

Akron University
ATTN: Government Documents
Bierce Library
Akron, OH 44325

Bowling Green State Univ
ATTN: Lib Govt Docs Services
Library Bldg
Bowling Green, OH 43402

Case Western Reserve University
Freiberger Library
11161 East Blvd
Cleveland, OH 44106

Cincinnati University Library
Cincinnati, OH 45221

Cleveland Public Library
ATTN: Documents Collection
325 Superior Avenue
Cleveland, OH 44114

Cleveland State Univ Lib
1860 E 22nd Street
Cleveland, OH 44115

Columbus & Franklin Cty Public Lib
96 South Grant Avenue
Columbus, OH 43215

Dayton & Montgomery City Pub Lib
215 E 3rd St
Dayton, OH 45402

Dayton, University of
300 College Park Ave
Dayton, OH 45469

Denison Univ Library
Granville, OH 43023

Kent State University Library
Kent, OH 44242

Kenyon College Library
Gambier, OH 43022

Miami Univ Library
Oxford, OH 45056

Oberlin College Library
Oberlin, OH 44074

Ohio State Library
State Office Bloc
65S Front St
Columbus, OH 43215

Ohio State University
ATTN: Libraries Documents Division
1858 Neil Ave
Columbus, OH 43210

Ohio University Library
Athens, OH 45701

Public Lib Cincinnati & Hamilton County
800 Vine Street
Cincinnati, OH 45202

Steubenville, University of
Starvaggi Memorial Library
Steubenville, OH 43952

Toledo Library, University of
2801 W Bancroft St
Toledo, OH 43606

Toledo Public Library
ATTN: Social Science Dept
325 Michigan St
Toledo, OH 43624

Wooster, College of
ATTN: Government Documents
Andrews Library
Wooster, OH 44691

Wright State Univ Library
Dayton, OH 45435

Oklahoma

Veterans Administration—RO
ATTN: Director
Federal Building
125 S Main Street
Muskogee, OK 74401

Central State University
ATTN: Library Documents Dept
Edmond, OK 73034

East Central University
Linscheid Library
Ada, OK 74802

Northeastern Oklahoma State Univ
John Vaughan Library
Tahlequah, OK 74464

Northwestern State Univ Library
Alva, OK 73717

Oklahoma City Univ Library
2501 North Blackwelder
Oklahoma City, OK 73106

Oklahoma City Univ Library
Stillwater, OK 74074

Oklahoma Dept of Libs
ATTN: U S Govt Documents
200 NE 18th St
Oklahoma City, OK 73105

Oklahoma, University of
ATTN: Documents Div
P O Box 2758
Boulevard Station
Norman, OK 73069

Tulsa, University of
McFarlin Library
600 S College
Tulsa, OK 74104

Oregon

Veterans Administration—RO
ATTN: Director
Federal Building
1220 SW 3rd Avenue
Portland, OR 97204

Eastern Oregon College Library
La Grande, OR 97850

Oregon State Library
State Library Bldg
Salem, OR 97310

Oregon, University of
ATTN: Documents Section
University Library
Eugene, OR 97403

Portland Library, Assoc of
Social Sci & Sci Dept
801 SW 10th Ave
Portland, OR 97205

Portland State Univ Lib
P O Box 1151
Portland, OR 97207

Reed College Library
3203 SE Woodstock
Portland, OR 97202

Southern Oregon College
ATTN: Library
1250 Sisiyou Blvd
Ashland, OR 97520

Pennsylvania

Veterans Administration-RO
ATTN: Director
1000 Liberty Avenue
Pittsburgh, PA 15222

Veterans Administration—RO
ATTN: Director
5000 Wissahickon Avenue
Philadelphia, PA 19144

Allegheny College
Pelletier Library
North Main Street
Meadville, PA 16335

Altoona Area Public Library
1600 Fifth Ave
Altoona, PA 16602

Bucknell University
Ellen Clarke Bertrand Lib
Lewisburg, PA 17837

Carnegie Library of Pittsburgh
4400 Forbes Avenue
Pittsburgh, PA 15213

Carnegie Mellon University
ATTN: Director of Libraries
Pittsburgh, PA 15213

John J Wright Library
La Roche College
9000 Babcock Blvd
Pittsburgh, PA 15237

Millersville State College
Ganser Library
Millersville, PA 17551

Pennsylvania State Library
ATTN: Government Publications Section
P O Box 1601
Harrisburg, PA 17105

Pennsylvania State University
ATTN: Library Document Sec
University Park, PA 16802

Pennsylvania, University of
ATTN: Director of Libraries
3420 Walnut Street
Philadelphia, PA 19104

Philadelphia, Free Lib of
ATTN: Govt Publications Dept
Logan Square
Philadelphia, PA 19103

Pittsburg, University of
ATTN: Documents Office GB
Hillman Library
Pittsburgh, PA 15260

Reading Public Library
5th & Franklin Sts
Reading, PA 19602

Scranton Public Library
N Washington & Vine Streets
Scranton, PA 18503

Slippery Rock State College Library
Slippery Rock, PA 16057

Swarthmore College Lib
ATTN: Reference Dept
Swarthmore, PA 19081

Temple University
Paley Library Docs Rm
Philadelphia, PA 19122

West Chester State Coll
ATTN: Documents Dept
Francis Harvey Green Library
West Chester, PA 19380

Westmoreland Cty Comm College
ATTN: Learning Resource Ctr
Armbrust Rd
Youngwood, PA 15697

Philippines

Veterans Administration—RO
ATTN: Director
1131 Roxas Blvd
Manila, Phillippines
APO San Francisco 96528

Puerto Rico

Veterans Administration—RO
ATTN: Director
U S Courthouse & Federal Bldg
Carlos E Chardon Street
Hato Rey
San Juan, PR 00918

Puerto Rico, University of
ATTN: Doc & Maps Room
General Library
San Juan, PR 00931

Rhode Island

Veterans Administration—RO
ATTN: Director
321 S Main Street
Providence, RI 02903

Brown University
John D Rockefeller Jr Library
Prospect Street
Providence, RI 02912

Providence College
Phillips Mem Library
River Ave at Eaton St
Providence, RI 02918

Providence Public Library
150 Empire St
Providence, RI 02903

Westerly Public Library
Memorial Library Association of Westerly
Broad St, Box 356
Westerly, RI 02891

Rhode Island Library, University of
ATTN: Govt Publications Office
Wakefield, RI 02881

Rhode Island, University of
ATTN: Director of Libraries
Kingston, RI 02908

South Carolina

Veterans Administration—RO
ATTN: Director
1801 Assembly Street
Columbia, SC 29201

Charleston County Library
404 King St.
Charleston, South Carolina 29403

Clemson University
ATTN: Director of Libraries
Clemson, SC 29631

Greenville County Library
300 College St
Greenville, SC 29601

Richland County Pub Lib
1407 Sumter Street
Columbia, SC 29201

South Carolina State Library
1500 Senate Street
Columbia, SC 29201

South Carolina, University of
ATTN: Government Documents
Thomas Cooper Library
Columbia, SC 29208

Winthrop College
ATTN: Documents Dept
Dacus Library
Rock Hill, SC 29733

South Dakota

Veterans Administration—RO
ATTN: Director
Courthouse Plaza Bldg
300 North Dakota Avenue
Sioux Falls, SD 57101

H M Briggs Library
South Dakota University
University Station
Brookings, SD 57006

Rapid City Public Library
P O Box 3090
Rapid City, SD 57709

South Dakota Sch of Mines & Tech Library
Rapid City, SD 57701

South Dakota State Library
ATTN: Federal Documents Department
State Library Bldg
Pierre, SD 57501

South Dakota, University of
ATTN: Documents Librarian
I D Weeks Library
Vermillion, SD 57069

Tennessee

Veterans Administration—RO
ATTN: Director
110 9th Avenue S
Nashville, TN 37203

Chattanooga Hamilton Co
Bicentennial Library
1001 Broad Street
Chattanooga, TN 37402

East Tennessee State Univ
ATTN: Documents Dept
Sherrod Lib
University Station
Johnson City, TN 37614

Memphis & Shelby Co
Pub Lib & Info Ctr
1850 Peabody Ave
Memphis, TN 38104

Memphis State University
John W Brister Library
Memphis, TN 38152

Public Library of Nashville
and Davidson County
8th Ave North at Union
Nashville, TN 37203

Tennessee Technological University
Jere Whitson Mem Library
Cookeville, TN 38501

Tennessee, University of
ATTN: Director of Libraries
Knoxville, TN 37916

Vanderbilt University Library
ATTN: Govt Documents Section
Central Documents Unit
Nashville, TN 37203

Texas

Veterans Administration-RO
ATTN: Director
2515 Murworth Drive
Houston, TX 77054

Veterans Administration—RO
ATTN: Director
1400 N Valley Mills Drive
Waco, TX 76710

Angelo State University Library
2601 West Avenue North
San Angelo, TX 76901

Arthur Hopkins Library
Austin College
Sherman, TX 75090

Baylor University Library
ATTN: Docs Dept
Box 6307, B U Station
Waco, TX 76706

Corpus Christi State University Lib
6300 Ocean Drive
Corpus Christi, TX 78412

Dallas County Public Library
414 South R L Thornton Freeway
Dallas, TX 75203

Dallas Public Library
Commerce Street
Dallas, TX 75201

East Texas State University
ATTN: Library
East Texas Station
Commerce, TX 75428

El Paso Public Library
ATTN: Documents & Geneology Dept
501 North Oregon Street
El Paso, TX 79901

Fort Worth Public Library
300 Taylor Street
Fort Worth, TX 76102

Hardin-Simmons University Library
Abilene, TX 79601

Houston Library, University of
ATTN Documents Div
3801 Cullen Blvd
Houston, TX 77004

Houston Public Library
Julia Ideson Bldg
500 McKinney
Houston, TX 77002

Midwestern University
Moffett Library
3410 Taft St
Wichita Falls, TX 76308

North Texas State Univ Library
North Texas, TX 76203

Pan American University Library
Edinburg, TX 78539

Rice University
ATTN: Director of Libraries
P O Box 1892
Houston, TX 77001

San Antonio Public Library
ATTN: Bus Science & Tech Dept
203 S St Marys St
San Antonio, TX 78205

Southern Methodist University
Fondren Library
Dallas, TX 75275

Texas A & M University Library
College Station, TX 77843

Texas at Arlington, University of
ATTN: Library Documents
Arlington, TX 76019

Texas at Austin, University of
Lyndon B Johnson Sch of Public Affairs
Austin, TX 78712

Texas at Austin, University of
ATTN: Documents Coll
Perry Castenada Lib Pcl 2402D
Austin, TX 78712

Texas at San Antonio, University of
ATTN: Library
San Antonio, TX 78285

Texas Christian University
Mary Couts Burnett Lib
Fort Worth; TX 76129

Texas State Library
ATTN: U S Documents Section
P O Box 12927
Austin, TX 78711

Texas Tech University Library
ATTN: Government Documents Dept
Lubbock, TX 79409

Trinity University Library
ATTN: Documents Collection
715 Stadium Dr
San Antonio, TX 78284

West Texas State University
ATTN: Library
West Texas Station
Canyon, TX 79015

Utah

Veterans Administration—RO
ATTN: Director
Federal Building
125 S State Street
Salt Lake City, UT 84138

Brigham Young University
ATTN: Documents Collection
Law Library
Provo, UT 84602

Brigham Young University
ATTN: Documents & Map Section
Lee Library
Provo, UT 84602

Southern Utah State College Library
ATTN: Documents Department
Cedar City, UT 84720

Utah State University
Merrill Library LRC
UMC 30
Logan, UT 84322

Utah, University of
ATTN: Special Collections
Marriott Library
Reference Librarian
Salt Lake City, UT 84112

Utah, University of
ATTN: Director of Libraries
Spencer S Eccles Health Sciences Lib
Building 89
Salt Lake City, UT 84112

Weber State College Library
3750 Harrison Blvd
Ogden, UT 84408

Vermont

Veterans Administration—RO
ATTN: Director
White River Junction, VT 05001

Middlebury College Library
Middlebury, VT 05753

Vermont, University of
ATTN: Director of Libraries
Burlington, VT 05405

Virginia

Veterans Administration—RO
ATTN: Director
210 Franklin Road, SW
Roanoke, VA 24011

Chesapeake Pub Lib System
Civic Ctr
300 Cedar Rd
Chesapeake, VA 23320

Hollins College
Fishburn Library
Hollins College, VA 24020

James Madison University
Madison Memorial Library
Harrisonburg, VA 22807

Norfolk Public Library
ATTN: R Parker
301 East City Hall Avenue
Norfolk, VA 23510

Old Dominion University
ATTN: Doc Dept Univ Library
Hampton Blvd
Norfolk, VA 23508

Virginia Commonwealth Univ
James B Cabell Library
901 Park Ave
Richmond, VA 23220

Virginia Military Institute
Preston Library
Lexington, VA 24450

Virginia Polytechnic Inst Lib
ATTN: Docs Dept
Blacksburg, VA 24061

Virginia State Library
ATTN: Serials Section
Richmond, VA 23219

Virginia, University of
ATTN: Public Documents
Charlottesville, VA 22903

William & Mary College
ATTN: Docs Dept
Swem Library
Williamsburg, VA 23185

Washington

Veterans Administration—RO
ATTN: Director
Federal Office Building
915 2nd Avenue
Seattle, WA 98174

Central Washington University
ATTN: Library Docs Section
Ellensburg, WA 98926

Eastern Washington Univ
The Library
Cheney, WA 99004

Everett Public Library
2700 Hoyt Ave
Everett, WA 98201

Seattle Public Library
ATTN: Ref Documents Asst
4th and Madison
Seattle, WA 98104

Spokane Public Library
ATTN: Reference Dept
West 906 Main Ave
Spokane, WA 99201

Tacoma Public Library
1102 S Tacoma Ave
Tacoma, WA 98402

Washington State Library
ATTN: Documents Section
Olympia, WA 98501

Washington State University
ATTN: Lib Documents Section
Pullman, WA 99164

Washington University Libraries FM-25
ATTN: Director of Libraries
Seattle, WA 98195

Western Washington Univ
Wilson Library
516 High St
Bellingham, WA 98225

Whitman College
Penrose Memorial Library
Walla Walla, WA 99362

West Virginia

Veterans Administration—RO
ATTN: Director
640 4th Avenue
Huntington, WV 24701

Salem College Library
Salem, WV 26426

West Virginia College of Grad Studies Lib
Institute, WV 25112

West Virginia, University of
ATTN: Director of Libraries (Regional)
Morgantown, WV 26506

Wisconsin

Veterans Administration-RO
ATTN: Director
342 N Water Street
Milwaukee, WI 53202

Beloit College Libraries
ATTN: Serials Documents Department
Beloit, WI 53511

Fond du Lac Public Lib
32 Sheboygan St
Fond du Lac, WI 54935

Lawrence University
ATTN: Documents Dept
Seeley G Mudd Library
Appleton, WI 54912

Marathon County Public Library
400 First Street
Wausau, WI 54401

Milwaukee Pub Lib
814 W Wisconsin Ave
Milwaukee, WI 53233

Superior Public Library
1204 Hammond Ave
Superior, WI 54880

Wisconsin at Whitewater, University of
ATTN: Government Documents Library
Harold Andersen Library
Whitewater, WI 53190

Wisconsin Milwaukee University
Library Docs
Milwaukee, WI 53201

Wisconsin Oshkosh University
Forrest R Polk Library
800 Algoma Blvd
Oshkosh, WI 54901

Wisconsin Platteville University
Doc Unit Library
725 W Main St
Platteville, WI 53818

Wisconsin Univ at Stevens Point
ATTN: Docs Section
Learning Resources Ctr
Stevens Point, WI 54481

Wisconsin, University of
ATTN: Govt Pubs Dept
Green Bay Library
Green Bay, WI 54302

Wisconsin, University of
ATTN: Acquisitions Department
Memorial Library
728 State Street
Madison, WI 53706

Wyoming

Veterans Administration—RO
ATTN: Director
2360 E Pershing Blvd
Cheyenne, WY 82001

Central Wyoming College Library
P O Box 80
Riverton, WY 82501

Coe Library
ATTN: Documents Division
P O Box 3334
University Station
Laramie, WY 82701

Natrona County Public Library
307 East Second Street
Casper, WY 82601

Western Wyoming Community College Lib
2500 College Drive
Rock Springs, WY 82901

Wyoming State Library
Supreme Court & Library Bldg
Cheyenne, WY 82001

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NTPR

2 May 1983

SUBJECT: Document Declassification Status List

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Attached is a copy of the DNA Library's latest list of documents relating to personnel participation in the atmospheric nuclear weapons testing which are cleared for public release or in the process of being made available for public release.

This list supersedes the list dated 1 April 1983 which should be discarded.

Sincerely,

HLReese

H. L. REESE
Lt Col, USAF
Manager
NTPR Program

1 Enclosure
as

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Chief Counsel
Committee on Veterans Affairs
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Alexandria, VA 22331

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Brooks AFB, TX 78235

HQ USMC (Capt Schinabeck)
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COL Paul Fallon
HQ USAF/SGES
Bolling AFB
Washington, DC 20332

Captain W. H. Loefler
Navy NTPR
Commonwealth Bldg, Rm 756
1300 Wilson Blvd.
Arlington, VA 22209

Commander
FCDNA
ATTN: FCLS (MAJ Stinson)
Kirtland AFB, NM 87115

JAYCOR (Mr. Nelson)
205 S. Whiting Street
Alexandria, VA 22304

NAS-NRC (Dr. Robinette)
2101 Constitution Avenue, NW
Washington, DC 20418

DoE-MA (Ms Kris Morris)
Mail Stop A-224
Washington, DC 20545

Documents listed in the enclosed report are broken into the following categories:

In Process: This section lists classified documents that are being reviewed by the Defense Nuclear Agency, Classification Management Division for possible declassification. In some cases, the documents cannot be declassified but are santized so that extracted versions may be published and made available to the public.

Eligible: Documents listed as eligible have been reviewed by the DNA Classification Management Division and have been approved for public release. They are currently being processed and will be available for sale from the National Technical Information Service in the near future.

Releaseable: Documents listed under this category are available for sale to the public from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. Requestor's may order the documents by mail or by telephone by ordering the AD number shown for each document. The telephone number for NTIS is (703) 487-4650.

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                                                     GENERAL

       PRI-RPT                          SEC-RPT                  ORG-DT      H-CLASS     PG-LF       DDC-AD-NO      DTL-NO

AFSAM 55-8                                                       550300         U        0000                       002132
ORG-AG SCHOOL OF AVIATICA MEDICINE                                   AUTHOR  KONECCI E B
TITLE  BIOLOGICAL AND MEDICAL ASPECTS OF IONIZING RADIATION

AFSC-HPS-61-142-1                SWEH-2-003                      630100        RS        0300                       801718
ORG-AG SPECIAL WEAPONS CENTER. AF                                    AUTHOR
TITLE  HISTCRY OF AIR FORCE ATOMIC CLOUD SAMPLING

CWLR-2282                                                        590700        FC        0055       381227          005301
ORG-AG CHEMICAL CENTER. ARMY                                         AUTHOR  KINCH J W
TITLF  ACTIVATION TYPE NEUTPON DETECTION SYSTEM AND ITS CALIBATION

DRCL-393                                                         630201       B U        0012                       005107
ORG-AG DEFENCE RES BOARD. ONTARIO                                    AUTHOR  FLYNN J T
TITLE  RESPONSE OF TACTICAL AND PERSONAL DOSIMETERS TO INITIAL RADIATION FROM NUCLEAR WEAPONS

NOL-TR-53                                                        650700       RS1        0124       365419L         011872
ORG-AG NUCLEAR EFFECTS LAB. ARMY                                     AUTHOR  SMITH R J
TITLE  INITIAL GAMMA DATA FRCM NUCLEAR WEAPON TESTS 1948 THROUGH 1962

NRDL-TR-860                                                      650610       RS1        0044                       012865
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                AUTHOR  TOMNOVEC F M
TITLE  REVIEW OF NRDL NEUTRON INDUCED ACTIVITY STUDIES, METHOD FOR PREDICTING INDUCED ACTIVITY RADIATION FIELDS FOR A GIVEN S
       L TYPE



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RUN DATE:  05/02/83                       IN PROCESS FOR RELEASE TO THE PUBLIC                              PAGE:     1
                                                 CROSSROADS        1946

       PRI-RPT                       SEC-RPT              ORG-DT      H-CLASS     PG-LF      DDC-AD-NO      DTL-NO

XRD-167-AP-9                                              510706         U         0020       473888         020858
ORG-AG JOINT TASK FORCE 1                                       AUTHOR
TITLE  EFFECTS OF AN ATOMIC BOMB EXPLOSION ON CORN SEEDS, APPENDIX 9

XRD-172-AC-14                                             510706         U         0008       473892         020863
ORG-AG JOINT TASK FORCE 1                                       AUTHOR  WENZEL P F
TITLE  EFFECT OF THE BIKIAI ATCMIC BOMB TEST ABLE ON SOIL MICROORGANISMS, APPENDIX 14

XRD-179-AP-25                                             650303         U         0010       473898         020870
ORG-AG JOINT TASK FORCE 1                                       AUTHOR
TITLE  COMPARISON OF THE EFFECTS OF TEST ABLE ATCMIC BOMB IONIZING RADIATION AND XRAYS CN SEEDS OF BARLEY, WHEAT AND CATS, APPE
       NDIX 25

XRD-188                                                   650303         U         0017       473988         020879
ORG-AG JOINT TASK FORCE 1                                       AUTHOR
TITLE  CHRONOLOGICAL HISTCRY OF THE ACTIVITIES OF THE DIRECTOR OF SHIP MATERIAL, JCINT TASK FORCE ONE ABROAD THE U.S.S. RECLAIM
       ER (AR942) DURING TEST BAKER
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                                           SANDSTONE        1948

       PRI-RPT                       SEC-RPT               ORG-DT      H-CLASS     PG-LF       DDC-AD-NO      DTL-NO

SANDSTONE-38                                               480715        RS1       0082                       015249
ORG-AG ATOMIC ENERGY COPPISSICN                                  AUTHOR  MCCORD W O
TITLE  OPERATION SANDSTCNE, SCIENTIFIC DIRECTCRS REPORT OF ATOMIC WEAPON TESTS, ANNEX 15 - PART 3 - LAJ-128 ACTIVITIES
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112

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                                          UNCLASSIFIED
RUN DATE:  05/02/83                IN PROCESS FOR RELEASE TO THE PUBLIC                                PAGE:     1
                                         BUSTER JANGLE    1951

       PRI-RPT                      SEC-RPT                     ORG-DT      H-CLASS     PG-LF     DOC-AD-NO      DTL-NO

NRL-3972                   WT-3C7                               520300         RSI      0052                     018813
ORG-AG NAVAL RES LAB                                                  AUTHOR   DUNNING K A
TITLE  MEASUREMENT OF NEUTRON MULTIPLICATION RATE AND TRANSIT TIME

WT-341                                                          520315          U       0022                     018820
ORG-AG DEPARTMENT OF THE AIR FORCE                                    AUTHOR   BYRNES V A
TITLE  FLASH BLINDNESS
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                                              UNCLASSIFIED
RUN DATE:  05/02/83                 IN PROCESS FOR RELEASE TO THE PUBLIC                                      PAGE:     1
                                           UPSHOT-KNOTHOLE  1953

         PRI-RPT                            SEC-RPT               ORG-DT      H-CLASS      PG-LF      DDC-AD-NO      DTL-NO

HUMRRO                                                            531210         U          0034                     007446
ORG-AG  GEORGE WASHINGTON UNIV, HUMAN RESOURCES RES OFFICE            AUTHOR
TITLE   RELATION BETWEEN INFCRMATION GAIN AND ATTITUDE CHANGE, A STUDY OF PARTICIPANTS IN EXERCISE DESERT ROCK 5

SFO                                                               530800        RS          0104                     019191
ORG-AG  SANTA FE OPERATICNS, AEC                                      AUTHOR
TITLE   OPERATION UPSHOT KNCTHOLE OPERATIONAL SUMMARY, 1 MARCH - 9 JUNE 1953

WT-731                                                            540100         U          0084      480245         019084
ORG-AG  DEPT OF AGRICULTURE                                           AUTHOR  SAUER F M
TITLE   BLAST DAMAGE TC CCNIFERCUS TREE STANDS BY ATOMIC EXPLOSICNS, OPERATION UPSHCT KNOTHOLE, PROJECT 3.19

WT-743                                                            531200        RS1         0064                     019098
ORG-AG  CAMBRIDGE RES CENTER. AF ELECTRONICS RES DIRECT.              AUTHOR  LANGHAM W H
TITLE   RADIATION HAZARDS TO PERSCNNEL WITHIN AN ATOMIC CLOUD

WT-747                                                            531200        RC          0058                     019094
ORG-AG  NAVAL RADIOLOGICAL DEFENSE LAB                                AUTHOR  CARTER R E
TITLE   CPERATICN UPSHOT KNOTHOLE, THE BIOLOGICAL EFFECTS OF NEUTRONS, PROJECT 4.8

WT-825                                                            551100        RS1         0226                     019177
ORG-AG  SPECIAL WEAPONS CENTER. AF                                    AUTHOR  FACKLER P H
TITLE   AIRCRAFT PARTICIPATION
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RUN DATE: 05/02/83                           IN PROCESS FOR RELEASE TO THE PUBLIC                                      PAGE:     1
                                                     CASTLE           1954

        PRI-RPT                         SEC-RPT                ORG-DT      H-CLASS      PG-LF        DDC-AD-NO        DTL-NO

J-17390                                                        530303          RS        0045                         010441
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                    AUTHOR
TITLE  SUMMARY OF NOTES CA A MEETING HELD AT LOS ALAMOS , NEW MEXICO, 3 AND 4 MARCH 1953, TO DISCUSS, CASTLE PLANNING, WITH PAR
       TICULAR REFERENCE TC TU-13, OOD PROGRAM

JTF-7                                                          540614          RS        0225                         019331
ORG-AG JOINT TASK FORCE 7                                           AUTHOR
TITLE  OPERATION CASTLE, FINAL REPORT

JTF-7                                                          540000          RS        0337                         019315
ORG-AG JOINT TASK FORCE 7                                           AUTHOR
TITLE  RADIOLOGICAL SAFETY, CPFRATICN CASTLE, VOLUME 2, SPRING 1954

JTF-7                                                          540000          RS        0227                         019304
ORG-AG JOINT TASK FORCE 7                                           AUTHOR  BECHANAN  H G
TITLE  HISTORY OF OPERATION CASTLE, PACIFIC PROVING GROUND

JTF-7                                                          540000          RS        0406                         019314
ORG-AG JOINT TASK FORCE 7                                           AUTHOR
TITLE  RADICLOGICAL SAFETY, VOLUME 1

JTF-7                                                          530210           S        0181                         801484
ORG-AG JOINT TASK FORCE 7                                           AUTHOR
TITLE  CASTLE 7.2 FUNCTICNS, VCLUME 1 - HISTORICAL INSTALLATIONS 2, 3 AND 4

JTF-7-OP-3-53                                                  540210           S        0112                         019321
ORG-AG JOINT TASK FORCE 7                                           AUTHOR
TITLE  JOINT TASK FORCE 7, OPERATICN PLAN 3-53, CPERATION CASTLE

NRL-4519                                                       550300          RS        0043                         012956
ORG-AG NAVAL RES LAB                                                AUTHOR  BECK C A
TITLE  HIGH RESOLUTICN SPECTROSCOPY, OPERATION CASTLE


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RUN DATE:  05/02/83                IN PROCESS FOR RELEASE TO THE PUBLIC                        PAGE:     2
                                      CASTLE          1954

       PRI-RPT                     SEC-RPT               ORG-OT      H-CLASS      PG-LF       DDC-AD-NO      DTL-NO

NYO-4645                                                 550517          RS        0118                      013285
ORG-AG WEATHER BUREAU, ARCTIC OPERATIONS PROJECT             AUTHOR   LIST R J
TITLE  WORLD WIDE FALLOLT FRCM CPERATION CASTEL
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                                                                 TEAPOT          1955

         PRI-RPT                          SEC-RPT                ORG-DT      H-CLASS      PG-LF       DDC-AD-NO       DTL-NO

FTG-5P--OP-1-54                                                  541220        RS         0247                        019591
ORG-AG SPECIAL WEAPONS CENTER. AF                                     AUTHOR
TITLE  FIELD TEST GROUP 5(PRCV) OPERATION PLAN 1-54 FOR OPERATION TEAPOT

ITR-1188                                                         550500         U         0046                        019537
ORG-AG EG AND G INC                                                   AUTHOR  OKEEFE B J
TITLE  TECHNICAL PHOTOGRAPHY OF PHYSICAL PHENOMENA

ITR-1193                                                         550500         U         0066                        019545
ORG-AG FEDERAL CIVIL DEFENSE ADM                                      AUTHOR  WILLIAMSON
TITLE  EFFECTS OF A NUCLEAR EXPLCSICN ON COMMERCIAL COMMUNICATIONS EQUIPMENT

WT-1153                                                          000000        RS         0235                        019480
ORG-AG CEFENSE ATOMIC SUPPORT AGENCY                                  AUTHOR   -
TITLE  TECHNICAL SUMPARY CF PILITARY EFFECTS, PRCGRAMS 1-9, OPERATION TEAPOT

WT-1161                                                          570121         U         0192      224424            019487
ORG-AG SANDIA LABS                                                    AUTHOR  VORTMAN L J
TITLE  EFFECTS OF AN ATCMIC EXPLOSION ON GROUP AND FAMILY TYPE SHELTERS

WT-1180                                                          570625         U         0043                        019523
ORG-AG SANDIA LABS                                                    AUTHOR  HIRSCH F G
TITLE  EFFECTS CF NCISE IN ELAST RESISTANT SHELTERS

WT-1181                                                          570828         U         0053      611318            019525
ORG-AG FEDERAL CIVIL DEFENSE ADM                                      AUTHOR  SHAW E R
TITLE  EXPOSURE OF MCBILE HCPES AND EMERGENCY VEHICLES TO NUCLEAR EXPLOSIONS

WT-1184                                                          561214         U         0065                        019531
ORG-AG SANDIA AREA OFFICE. AEC                                        AUTHOR  SPARKS L N
TITLE  NUCLEAR EFFECTS CF MACHINE TOOLS

WT-1187                                                          570513         U         0016                        019536
ORG-AG EG AND G INC                                                   AUTHOR  CORSBIE R L
TITLE  THERMAL RADIATICN MEASUREMENT


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        PRI-RPT                      SEC-RPT                ORG-DT     H-CLASS     PG-LF        DOC-AD-NO       DTL-NO

WT-1189                                                     560200         U       0107                         019539
ORG-AG FEDERAL CIVIL DEFENSE ADM                                   AUTHOR  JOHNSTON B G
TITLE  DAMAGE TO COMMERCIAL AND INDUSTRIAL BUILDING EXPOSED TO NUCLEAR EFFECTS


WT-1191                                                     580618         U       0043                         019543
ORG-AG FEDERAL CIVIL DEFENSE ADM                                   AUTHOR  LLOYD W J
TITLE  EFFECTS OF A NUCLEAR EXPLOSION ON RECORDS AND RECORDS STORAGE EQUIPMENT


WT-1197                                                     551200         U       0030                         019552
ORG-AG LOVELACE FOUNDATION FOR MEDICAL EDUC AND RES                AUTHOR  PALMER M A
TITLE  TECHNICAL PHOTOGRAPHY (HIGH SPEED - BLAST BIOLOGY)
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RUN DATE:  05/02/83                       UNCLASSIFIED
                               IN PROCESS FOR RELEASE TO THE PUBLIC                                    PAGE:     1
                                       REDWING          1956

      PRI-RPT                         SEC-RPT                  ORG-DT      H-CLASS      PG-LF      DOC-AD-NO      DTL-NO
ALOO
ORG-AG ALBUQUERQUE OPERATICNS OFFICE, AEC                      561026         RS         0220                     800371
TITLE  OPERATION REDWING, PACIFIC PROVING GROUND, SPRING AND SUMMER 1956, REPORT OF THE MANAGER, ALBUQUERQUE DIVISION
                                                                   AUTHOR

JTF-7
ORG-AG JOINT TASK FORCE 7                                      000000         RS         0230                     800372
TITLE  OPERATION REDWING RADIOLOGICAL SAFETY                       AUTHOR

JTFMC-TP-1-V-3-P-2
ORG-AG JOINT TASK FORCE SEVEN                                  560000         U          0179                     009389
TITLE  METECROLOGICAL REPCRT CN OPERATION REDWING, VOLUME 3, PART 2 - METEOROLOGICAL ANALYSES
                                                                   AUTHOR  HANLON B

WT-1317
ORG-AG NAVAL RADIOLOGICAL CEFENSE LAB                          610315         RSI        0310     341068L         019625
TITLE  CHARACTERIZATION CF FALLOUT                                 AUTHOR  TRIFFET T
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                                        HARDTACK I       1958

      PRI-RPT                    SEC-RPT              ORG-DT      H-CLASS      PG-LF       DOC-AD-NO       DTL-NO

WT-1637                                               610807         RS        0073       339276L         020017
ORG-AG SANDIA LABS                                          AUTHOR  CONRAD E E
TITLE  EFFECTS OF NUCLEAR RADIATION ON ELECTRONIC FUZE COMPONENTS AND MATERIALS
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                                            HARDTACK II      1958

       PRI-RPT                    SEC-RPT                ORG-DT      H-CLASS      PG-LF        DOC-AD-NO        DTL-NO

OTO-58-4                                                 581001          RS1       0117                          020144
ORG-AG ATOMIC ENERGY COPPISSICN                                AUTHOR
TITLE  OPERATION HARDTACK, PHASE 2, AUGUST - OCTOBER 1958, NEVADA TEST SITE
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                                       SUNBEAM        1961

       PRI-RPT                    SEC-RPT             ORG-DT     H-CLASS    PG-LF      DOC-AD-NO     DTL-NO

GA-8472                                               680131        U       0048                     104635
ORG-AG GENERAL DYNAMICS                                     AUTHOR  NORMAN J H
TITLE  CLOUD CHEMISTRY CF FALLOUT FORMATION
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RUN DATE:  05/02/83                  IN PROCESS FOR RELEASE TO THE PUBLIC                                  PAGE:      1
                                          DOMINIC I          1962

     PRI-RPT                   SEC-RPT                   ORG-DT      H-CLASS     PG-LF      DDC-AD-NO      DTL-NO

NRDL-TR-860                                              650610        RS1        0044                     012865
ORG-AG NAVAL RADICLOGICAL DEFENSE LAB                            AUTHOR  TOMNOVEC F M
TITLE  REVIEW OF NRDL NEUTRCA INDUCED ACTIVITY STUDIES, METHOD FCR PREDICTING INDUCED ACTIVITY RADIATION FIELDS FOR A GIVEN SOI
       L TYPE

POR-2006                                                 630916        RS1        0152                     020280
ORG-AG BUREAU OF SHIPS                                           AUTHOR  KEARNS J J
TITLE  SHIP DAMAGE ASSESSMENT AND TECHNICAL SUPPCRT OF TEST ELEMENTS, OPERATION DOMINIC

POR-2007                                                 630201        RS         0141      337433         020281
ORG-AG BALLISTIC SYSTEMS DIV. AF                                 AUTHOR  MURRAY W W
TITLE  SCIENTIFIC DIRECTCRS SUMMARY REPORT, OPERATION DOMINIC, SHOT SWORD FISH
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RUN DATE:  05/02/83                    DETERMINED TO BE ELIGIBLE FOR RELEASE TO THE PUBLIC                                PAGE:    1
                                                 TRINITY           1945

        PRI-RPT                              SEC-RPT                      ORG-DT      H-CLASS      PG-LF          DOC-AD-NO        DTL-NO

JRB-2-816-03-423-CO             DNA-6028F                                 821215        A U        0076                             830292
ORG-AG JRB ASSOCIATES                                                         AUTHOR   MAAG C
TITLE  PROJECT TRINITY 1945-1946, FINAL REPORT
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                                               SANDSTONE        1948

          PRI-RPT                      SEC-RPT                  ORG-DT      H-CLASS     PG-LF      DDC-AD-NO       DTL-NO

SANDSTONE-30                                                    490101        A  U       0337      A995174         015241
ORG-AG JOINT TASK FORCE 7                                             AUTHOR  ANDREWS H L
TITLE  SCIENTIFIC DIRECTORS REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1948, ANNEX 9,  PARTS 1, 2, 3, 4 AND 5 - CONTAMINATION S
       TUDIES
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                                                 BUSTER JANGLE    1951

       PRI-RPT                    SEC-RPT              ORG-DT     H-CLASS     PG-LF      DDC-AD-NO      DTL-NO

WT-390                                                 520605       A U        0035       A995173        810145
ORG-AG NAVAL ORDNANCE LAB                                    AUTHOR  YOUG G A
TITLE  CPERATION JANGLE, PROJECT 1(9)B, BASE SURGE ANALYSIS FOR NUCLEAR TESTS

WT-415                                                 520300       A U        0193       341046         019878
ORG-AG LOS ALAMCS SCIENTIFIC LABE                            AUTHOR  ZADINA E J
TITLE  BLAST MEASUREMENTS, OPERATION BUSTER JANGLE
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                                            GREENHOUSE       1951

       PRI-RPT                     SEC-RPT                ORG-DT      H-CLASS     PG-LF       DOC-AD-NO      DTL-NO

WT-47                                                     000000         A U       0232       A995169        018698
ORG-AG JOINT TASK FORCE 3                                         AUTHOR  CUESADA E R
TITLE  HISTORY CF OPERATICN GREENHOUSE
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                                             IVY            1952

     PRI-RPT                          SEC-RPT                ORG-DT     H-CLASS    PG-LF      DDC-AD-NO     DTL-NO

KT-82-026-R                     DNA-6036F                    821201       A U      0364                     830312
ORG-AG KAMAN TEMPO                                              AUTHOR  GLADECK F R
TITLE  OPERATION IVY, 1952
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                                                  UPSHOT-KNOTHOLE  1953

       PRI-RPT                           SEC-RPT                     ORG-DT      H-CLASS      PG-LF       DDC-AD-NO       DTL-NO

WT-733                                                               550200         U         0180       339904          019082
ORG-AG BALLISTIC RES LAB. ARMY                                           AUTHOR  BRYANT E
TITLE  STATISTICAL ESTIMATION OF DAMAGE TO ORDNANCE EQUIPMENT EXPOSED TO NUCLEAR BLASTS, OPERATION UPSHOT KNOTHOLE, PROJECT 3.2
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RUN DATE:  05/02/83                          DETERMINED TO BE ELIGIBLE FOR RELEASE TO THE PUBLIC                          PAGE:     1
                                                        TEAPOT          1955

       PRI-RPT                          SEC-RPT                    ORG-DT      H-CLASS      PG-LF        DDC-AD-NO        DTL-NO

AEC                                                                811101        A U        0152       A995154          820780
ORG-AG ATOMIC ENERGY COMMISSION                                          AUTHOR
TITLE  OPERATION TEAPOT, REPORT OF THE TEST MANAGER, JOINT TEST ORGANIZATION, EXTRACTED VERSION
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                                            SUNBEAM        1961

       PRI-RPT                   SEC-RPT                ORG-DT     H-CLASS     PG-LF       DDC-AD-NO       DTL-NO

JRB-2-816-03-423-00         DNA-6027F                   830131       A U        0218                       830349
ORG-AG JRB ASSOCIATES                                        AUTHOR  PONTON J
TITLE  OPERATION DOMINIC 2, SHOTS LITTLE FELLER 2, JOHNIE BOY, SMALL BOY, LITTLE FELLER I, 7 JULY - 17 JULY 1962
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                                                  GENERAL

        PRI-RPT                          SEC-RPT                     ORG-DT      H-CLASS     PG-LF      DDC-AD-NO      DTL-NO

AFSWP-155                                                            520314        A U       0014      875967         005543
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                                   AUTHOR  GIBSON T A
TITLE  RESIDUAL RACIATICN PATTERN FOR VARIOUS SURFACE WIND VELOCITIES, UNDERWATER ATOMIC BURST


AFSWP-978-EX                                                         810515        A U       0138      A995153        820775
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                                   AUTHOR  MAXWELL R D
TITLE  EVALUATION OF RACICACTIVE FALLOUT, EXTRACTED VERSION


CWLR-2377-EX                                                         810515        A U       0143      A995129        811652
ORG-AG CHEMICAL RES AND CEVELOPMENT LABS. ARMY                                AUTHOR  MCNEILLY J H
TITLE  EXTERNAL NEUTPCN PEASURMENTS 1952 THROUGH 1958, EXTRACTED VERSION


DASA 532B                                                            600601        A U       0251      240642         005845
ORG-AG CEFENSE ATOMIC SUPPCRT AGENCY                                          AUTHOR  STEBBINS A K III
TITLE  A SPECIAL REPCRT CK THE HIGH ALTITUDE SAMPLING PROGRAM


DASA-1243-REV-69                                                     690800        A U       0040      859338         107221
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY                                          AUTHOR
TITLE  LIST OF MILITARY AND CIVIL DEFENSE RADIAC DEVICES                      1969 REPORT


DASIAC-SR-179-V-1             CNA-1251-1-EX                          790501        A U       0619      A079309        791660
ORG-AG GENERAL ELECTRIC CO. CASIAC                                            AUTHOR  HAWTHORNE H A
TITLE  COMPILATION OF LOCAL FALLOUT DATA FROM TEST DETONATIONS 1945-1962 EXTRACTED FROM DASA-1251, VOLUME 1 - CONTINENTAL U.S.
       TESTS


DASIAC-SR-179-V-2             CNA-1251-2-EX                          790501        A U       0351      A079310        791661
ORG-AG GENERAL ELECTRIC CC. CASIAC                                            AUTHOR  HAWTHORNE H A
TITLE  COMPILATION OF LOCAL FALLOUT DATA FROM TEST DETONATIONS 1945-1962 EXTRACTED FROM DASA-1251, VOLUME 2 - OCEANIC U.S. TEST
       S


DNA-5512F                                                            800806        A U       0080      A097038        810457
ORG-AG SCIENCE APPLICATICNS INC                                               AUTHOR  MCRANEY W
TITLE  RADIATICN DOSE RECCNSTRUCTION U.S. OCCUPATION FORCES IN HIROSHIMA AND NAGASAKI, JAPAN, 1945-1946, FINAL REPORT FOR 1 MAR
       CH 1980 - 6 AUGUST 1980


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                                                       GENERAL

        PRI-RPT                             SEC-RPT                 ORG-DT      H-CLASS     PG-LF      DOC-AD-NO        DTL-NO

DOD                                                                 770000         U        0653       A087568          771777
ORG-AG DEPARTMENT OF DEFENSE                                           AUTHOR  GLASSTONE S
TITLE  THE EFFECTS OF NUCLEAR WEAPONS, GPO STOCK NO 008-046-000-93-0

HODNA(AR)-124-3M                                                    760701        A U       0055       8011943          761254
ORG-AG DEFENSE NUCLEAR AGENCY                                          AUTHOR
TITLE  LIST OF MILITARY AND CIVIL DEFENSE RADIAC DEVICES

ITR-1824                                                            620601        A U       0023       A995171          020208
ORG-AG BOEING CO                                                       AUTHOR  CARLSON R H
TITLE  PERMANENT ANGULAR DISPLACEMENT OF CYLINDRICAL MODELS BURIED IN BASALT NEAR AN EXPLOSION CRATER, PROJECT DANNY BOY

NBS-MONO-42                                                         620601         U        0137       A995024          011678
ORG-AG NATIONAL BUREAU OF STANDARDS                                    AUTHOR  SPENCER L V
TITLE  STRUCTURE SHIELDING AGAINST FALLOUT RADIATION FROM NUCLEAR  WEAPONS

NCRP-38                                                             710104         U        0153                        112205
ORG-AG NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASU              AUTHOR
TITLE  PROTECTION AGAINST NEUTRON RADIATION

NRDL-TR-150                                                         570114        A U       0023       145696           012537
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                  AUTHOR  HEISKELL R H
TITLE  FLAME TREATING OF WOOD IN A SURFACE REMOVAL PROCESS FOR RADIOLOGICAL DECONTAMINATION

NRDL-TR-860-EX                                                      800201        A U       0074       8951744          800958
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                  AUTHOR
TITLE  REVIEW OF NRDL NEUTRON INDUCED ACTIVITY STUDIES, METHOD FOR PREDICTING INDUCED ACTIVITY RADIATION FIELDS FOR A GIVEN SOI
       L TYPE, EXTRACTED VERSION

ORNL-4992                                                           760300        A U       0507       ORNL4992         800664
ORG-AG OAK RIDGE NATIONAL LABORATORY                                   AUTHOR  KILLOUGH G
TITLE  A METHODOLOGY FOR CALCULATING RADIATION DOSES FROM RADIOACTIVITY RELEASED TO THE ENVIRONMENT

                                                     UNCLASSIFIED
        PRI-RPT                         SEC-RPT                       ORG-DT       H-CLASS      PG-LF        DDC-AD-NO        DTL-NO

RAND-RM-2108                  AFSWP-1074                            580131          A U         0122        244894           006173
ORG-AG RAND CORP                                                           AUTHOR  KNOX J B
TITLE  GRAPHICAL METHODS FOR THE QUANTITATIVE PREDICTION OF CLOSE-IN FALLOUT

SAI-72-511-LJ                 DNA-2860T                             720500          A U         0186        743171           112322
ORG-AG SCIENCE APPLICATIONS INC                                            AUTHOR  STRAKER E A
TITLE  MORSE CODE WITH COMBINATIONAL GEOMETRY, TOPICAL REPORT, 1   JANUARY 1971 - 28 FEBRUARY 1972

SAI-76-534-HJ                 DNA-4267F                             760700          A U         0260        A047389          771537
ORG-AG SCIENCE APPLICATIONS INC                                            AUTHOR  GRITZNER M L
TITLE  RADIATION ENVIRONMENTS FROM TACTICAL NUCLEAR WEAPONS, FINAL REPORT FOR 4 APRIL 1974 - 22 JULY 1976

SAI-76-561-LJ                 DNA-3995F                             760100          A U         0152        A047390          771530
ORG-AG SCIENCE APPLICATIONS INC                                            AUTHOR  HUSZAR L
TITLE  VERSION 4 OF ATR (AIR TRANSPORT OF RADIATION), FINAL REPORT FOR PERIOD 8 AUGUST 1973 - 30 SEPTEMBER 1975

TB-MED-254                    PAM-160-6-6                           570506          A U         0007        A095011          791530
ORG-AG ARMY                                                                AUTHOR
TITLE  PERMISSIBLE DOSE FROM EXTERNAL SOURCES OF IONIZING RADIATION
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       PRI-RPT                         SEC-RPT                 ORG-DT      H-CLASS      PG-LF       DOC-AD-NO        DTL-NO

JTF-1                                                          000000          A U        0140      A995049          020690
ORG-AG JOINT TASK FORCE 1                                              AUTHOR
TITLE  AIR OPERATIONS REPCRT OF CPERATICN CROSSROADS


XRD-165-AP-3                                                   510706          A U        0040      473886           020856
ORG-AG JOINT TASK FORCE 1                                              AUTHOR
TITLE  GROSS AUTOPSY FINDINGS AND A STATISTICAL STUDY OF THE           MORTALITY IN THE ANIMALS EXPOSED AT BIKINI, APPENDIX 3


XRD-170-AP-12                                                  461101          A U        0020      801408           020861
ORG-AG JOINT TASK FORCE 1                                              AUTHOR
TITLE  GERMINATION OF VEGETABLE SEEDS EXPOSED AT BIKINI DURING         THE ATOMIC BOMB TEST ABLE, APPENDIX 12


XRD-175-AP-17                                                  510504          A U        0003      473894           020866
ORG-AG JOINT TASK FORCE 1                                              AUTHOR
TITLE  ANALYSIS OF TISSUES FOR INDUCED RADIOACTIVITY, APPENDIX 17


XRD-176                                                        470203          A U        0007      473895           020867
ORG-AG NAVAL MEDICAL RES INST                                          AUTHOR  EICHER M
TITLE  VYCOR GLASS GAMMA RAY DOSIMETERS, APPENDIX 20 TO THE FINAL REPORT, OPERATION CROSSROADS


XRD-178                                                        000000          A U        0007      473897           020869
ORG-AG JOINT TASK FORCE 1                                              AUTHOR  BROWN M S
TITLE  ABERRATICNS FCUND IN THE PROGENIES OF PLANTS GROWN FROM IRRADIATED COTTON SEED, APPENDIX 23, FINAL REPORT


XRD-185-V-1                                                    490628          A U        0145      473906           020876
ORG-AG JOINT TASK FORCE 1                                              AUTHOR
TITLE  OPERATION CRCSSRCADS, RADIOLOGICAL DECONTAMINATION OF TARGET AND NON TARGET VESSELS, VOLUME 1


XRD-186-V-2.                                                   570114           A U       0145      473907           020877
ORG-AG JOINT TASK FORCE 1                                              AUTHOR  FEE J J
TITLE  OPERATION CROSSRCADS, RADIOLOGICAL DECONTAMINATION OF TARGET AND NON TARGET VESSELS, VOLUME 2


XRD-187-V-3                                                    571114          A U        0118      473908           020878
ORG-AG JOINT TASK FORCE 1                                              AUTHOR  FEE J J
TITLE  OPERATION CRCSSRCADS, RADIOLOGICAL DECONTAMINATION OF TARGET AND NON TARGET VESSELS, VOLUME 3


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        PRI-RPT                       SEC-RPT                ORG-DT      H-CLASS      PG-LF      DDC-AD-NO       DTL-NO

XRD-206-V-1                                                  460725        A U        0215       473986          020896
ORG-AG JOINT TASK FORCE 1                                          AUTHOR
TITLE  REPORT ON ATOMIC BCMB TESTS ABLE AND BAKER, VOLUME 1, OPERATION CROSSROADS, BIKINI ATOLL, MARSHALL ISLANDS ON 1 JULY 194
       6 AND 25 JULY 1946


XRD-208                                                      461118        A U        0211       367496          020899
ORG-AG JOINT TASK FORCE 1                                          AUTHOR  SHURCLIFF W A
TITLE  TECHNICAL REPCRT CF OPERATION CROSSROADS


XRD-212-A-1                                                  471200          U        0208       A077492         800269
ORG-AG JOINT TASK FORCE 1                                          AUTHOR
TITLE  BIKINI SCIENTIFIC RESURVEY, ANNEX 1 - REPCRT OF THE DIRECTOR OF SHIP MATERIAL U.S.S. SARATOGA (CV-3)

XRD-212-A-2                                                  471200          U        0119       A077493         800267
ORG-AG JOINT TASK FORCE 1                                          AUTHOR
TITLE  BIKINI SCIENTIFIC RESURVEY, ANNEX 2 - REPCRT OF THE DIRECTOR  OF SHIP MATERIAL U.S.S. PILOTFISH (S.S.-386)  (REMARK - TH
       IS DOCUMENT HAS BEEN JUDGED BY NTIS AS NON REPRODUCABLE DUE TO THE POOR QUALITY OF THE PHOTOGRAPHS AND FIGURES)

XRD-212-A-3                                                  471200          U        0057       A077494         800268
ORG-AG JOINT TASK FORCE 1                                          AUTHOR
TITLE  BIKINI SCIENTIFIC RESURVEY, ANNEX 3 - REPORT OF THE DIRECTOR OF SHIP MATERIAL U.S.S. APOGON (S.S.-308) AND NAGATO

XRD-212-A-4                                                  471200          U        0044       A077495         800270
ORG-AG JOINT TASK FORCE 1                                          AUTHOR
TITLE  BIKINI SCIENTIFIC RESURVEY, ANNEX 4, REPCRT OF THE TECHNICAL DIRECTOR

XRD-212-V-1                                                  471201        A U        0125       A077489         020904
ORG-AG JOINT TASK FORCE 1                                          AUTHOR
TITLE  BIKINI SCIENTIFIC RESURVEY, VOLUME 1 - OPERATIONS

XRD-212-V-2                                                  471201        A U        0117       A077490         020906
ORG-AG JOINT TASK FORCE 1                                          AUTHOR
TITLE  BIKINI SCIENTIFIC RESURVEY, REPORT OF THE TECHNICAL DIRECTOR, VOLUME 2


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      PRI-RPT                      SEC-RPT                ORG-DT      H-CLASS      PG-LF       DDC-AD-NO        DTL-NO

XRD-212-V-3                                               471200         U         0040       A077491          800271
ORG-AG JOINT TASK FORCE 1                                           AUTHOR
TITLE  BIKINI SCIENTIFIC RESURVEY, VOLUME 3 - REPORT OF THE DIRECTOR OF SHIP MATERIAL

XRD=2                                                     461216        A U        0125       366695           020694
ORG-AG JOINT TASK FORCE 1                                           AUTHOR  FOREST F X
TITLE  TECHNICAL INSPECTICN REPORT, BUREAU OF SHIPS GROUP, FINAL REPORT, TEST ABLE AND TEST BAKER, VOLUME 1, OPERATION CROSSROA
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                                                   SANDSTONE        1948

        PRI-RPT                     SEC-RPT                    ORG-DT      H-CLASS      PG-LF      DOC-AD-NO      DTL-NO

SANDSTONE-1                                                    480101       A U         0149       A078563        015207
ORG-AG  ATOMIC ENERGY COPPISSION                                         AUTHOR
TITLE   OPERATION SANDSTCNF, ATOMIC WEAPONS TESTS, OPERATION SANDSTONE, 1948, VOLUME 1 - REPORT TO JOINT CHIEFS OF STAFF

SANDSTONE-2                                                    480001       A U         0150       A078571        015208
ORG-AG  ATOMIC ENERGY COPPISSION                                         AUTHOR
TITLE   OPERATION SANDSTCNE, ATOMIC WEAPONS TESTS, OPERATION SANDSTONE, 1948, ANNEX 1 - PART 1 - VOLUME 1 - REPORT TO JOINT CHIE
        FS OF STAFF

SANDSTONE-3                                                    480000       A U         0258       A078545        015209
ORG-AG  ATOMIC ENERGY COPPISSION                                         AUTHOR
TITLE   OPERATION SANDSTCNE, ATOMIC WEAPONS TESTS, OPERATION SANDSTONE, 1948, ANNEX 1 - PART 2 - VOLUME1 - REPORT TO JOINT CHIEF
        S OF STAFF

SANDSTONE-31                                                   490501       A U         0145       A078554        015242
ORG-AG  ATOMIC ENERGY COPPISSION                                         AUTHOR
TITLE   CPERATICN SANDSTCKE, SCIENTIFIC DIRECTORS REPORT OF ATOMIC WEAPON TESTS, ANNEX 10 - RADIOLOGICAL SAFETY INSTRUMENTS

SANDSTONE-4                                                    480000       A U         0228       A078542        015210
ORG-AG  ATOMIC ENERGY COPPISSION                                         AUTHOR
TITLE   CPERATICN SANDSTCNE, ATOMIC WEAPONS TESTS, OPERATION SANDSTONE, 1948, ANNEX 1 - PART 3 - VOLUME 1 - REPORT TO JOINT CHIE
        FS OF STAFF

SANDSTONE-40                                                   800901       A U         0157       A995093        810731
ORG-AG  LOS ALAMOS SCIENTIFIC LAB                                        AUTHOR  LEMONS L
TITLE   OPERATION SANDSTCNE, NUCLEAR EXPLOSIONS - 1948, ANNEX 17, PART 1 OF SCIENTIFIC DIRECTORS REPORT, EXTRACTED VERSION

SANDSTONE-41                                                   480101       A U         0082       A078550        015252
ORG-AG  ATOMIC ENERGY COPPISSICN                                         AUTHOR
TITLE   OPERATION SANDSTCNE, SCIENTIFIC DIRECTORS REPORT OFF ATOMIC WEAPON TESTS, ANNEX 17 - PART 2 AND 3 - SANDIA LABORATORY GR
        OUP AND FORWARD AREA ADMINISTRATION

SANDSTONE-43                                                   480101       A U         0159       A078570        015254
ORG-AG  ATOMIC ENERGY COPPISSION                                         AUTHOR
TITLE   OPERATION SANDSTCNE, TG 7.6 CPERATIONS, OPERATION REPORT PHASES A,B,C,D,E

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                                        SANDSTONE        1948

      PRI-RPT                      SEC-RPT                 ORG-DT      H-CLASS     PG-LF       DDC-AD-NO        DTL-NO

SANDSTONE-5-EX                                             810101        A U        0400       A995107          810849
ORG-AG JOINT TASK FORCE 7                                        AUTHOR
TITLE  REPORT TO THE U.S. ATCMIC ENERGY COMMISSICN ON OPERATION SANDSTONE ATOMIC WEAPON PROOF TESTS, EXTRACTED VERSION

SANDSTONE-6-V-2-P-1                                        480000        A U        0228       B951727          015212
ORG-AG JOINT TASK FORCE 7                                        AUTHOR
TITLE  CPERATION SANCSTCNE, TEST DIRECTOR, JOINT TASK FORCE 7, REPORT TO THE U.S. ATOMIC ENERGY COMMISSION ON OPERATION SANDSTO
       NE, ATOMIC WEAPOK PRCCF TESTS

SANDSTONE-7-EX                                             810101        A U        0255       A995094          810738
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                 AUTHOR  FROMAN D
TITLE  OPERATION SANDSTCNE, NUCLEAR EXPLOSIONS - 1948, SCIENTIFIC DIRECTORS REPORT, VOLUME 1 - GENERAL REPORT, EXTRACTED VERSIO
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        PRI-RPT                              SEC-RPT                ORG-DT     H-CLASS     PG-LF      DOC-AD-NO       DTL-NO
ARMY                                                                511215       A U       0274       B951583         007439
ORG-AG CEPARTMENT OF THE ARMY                                          AUTHOR
TITLE  REPORT OF TEST EXERCISES DESERT ROCK 2 AND 3


ARMY 3RD CORP                                                       520626       A U       0125       A078556         007441
ORG-AG DEPARTMENT OF THE ARPY                                          AUTHOR
TITLE  EXERCISE DESERT ROCK 1


CDR                                                                 000000       A U       0023       A077503         791138
ORG-AG CAMP DESERT RCCK, ARMY                                          AUTHOR
TITLE  EXERCISE DESERT RCCK INFORMATION AND GUIDE


DESERT-ROCK                                                         520200       A U       0100       AG78558         007442
ORG-AG HUMAN RESOURCES RES ORGANIZATION                                AUTHOR
TITLE  STUDY OF SOLDIER ATTITUDES AND KNOWLEDGE ABOUT ATOMIC EFFECTS, EXERCISE DESERT ROCK, OCTOBER - NOVEMBER, 1951

DR-4-1                                                              530726       A U       0117       001645          007445
ORG-AG GEORGE WASHINGTON UNIV, HUMAN RESOURCES RES OFFICE              AUTHOR
TITLE  DESERT ROCK 4, REACTICNS CF AN ARMORED INFANTRY BATTALION TO AN ATOMIC BOMB MANEUVER, REPORT 1 - PRINCIPAL TRENDS DURING
         THE RESEARCH PERIOD

HUMRRO                                                              540300       A U       0018       402184          007465
ORG-AG GEORGE WASHINGTOK UNIV                                          AUTHOR  WINOGRAD B
TITLE  GAIN IN INFORMATICK IK THE DESERT ROCK A-BOMB MANEUVERS

HUMRRO-TR-1                                                         530201       A U       0152       006092          007440
ORG-AG GEORGE WASHINGTON UNIV, HUMAN RESOURCES RES OFFICE              AUTHOR  BORDES P A
TITLE  DESERT ROCK 1 - A PSYCHOLCGICAL STUDY OF TROOP REACTIONS TO AN ATOMIC EXPLOSION

HUMRRO-TR-1-S                                                       530313       A U       0015       815859          780211
ORG-AG HUMAK RESOURCES RES OFFICE                                      AUTHOR  HOCHSTIP J R
TITLE  DESERT ROCK 1 - A PSYCHOLCGICAL STUDY OF TROOP REACTIONS TO AN ATOMIC EXPLOSION, SUPPLEMENT
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         PRI-RPT                       SEC-RPT                     ORG-DT     H-CLASS      PG-LF       DDC-AD-NO        DTL-NO

JRB-2-816-03-423-CO          DNA-6023F                             820621        A U        0190        A123441          830050
ORG-AG JRB ASSOCIATES                                                      AUTHOR  PONTON J
TITLE  OPERATION BUSTER JANGLE, 1951

JRB-2-816-03-423-00          DNA-6024F                             820622        A U        0140        A122358          821307
ORG-AG JRB ASSOCIATES                                                      AUTHOR  PONTON J
TITLE  SHOTS ABLE TO EASY, THE FIRST FIVE TESTS OF THE BUSTER JANGLE SERIES, 22 OCTOBER - 5 NOVEMBER 1951

JRB-2-816-03-423-00          DNA-6025F                             820623        A U        0132        A122243          821201
ORG-AG JRB ASSOCIATES                                                      AUTHOR  PONTON J
TITLE  SHOTS SUGAR AND UNCLE, THE FINAL TESTS OF THE BUSTER JANGLE SERIES, 19 NOVEMBER - 29 NOVEMBER 1951

NRDL-374                                                           521128        A U        0018        828637           012402
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                      AUTHOR  ADAMS C
TITLE  NATURE OF INDIVIDUAL RADIOACTIVE PARTICLES, 1 - SURFACE AND UNDERGROUND ABD PARTICLES FROM OPERATION JANGLE

NRDL-399                                                           531016        A U        0018        A078578          012404
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                      AUTHOR  LAURINO R K
TITLE  CONTAMINATION PATTERNS AT OPERATION JANGLE

ORG-T-170                                                          520625        A U        0032        A078552          013569
ORG-AG JOHN HOPKINS UNIV                                                   AUTHOR  HPUSRATH A H
TITLE  TROOP PERFORMANCE ON A TRAINING MANEUVER INVOLVING THE USE OF ATOMIC WEAPONS

WT-306                                                             520219        A U        0227        A078577          095058
ORG-AG SANDIA CORP                                                         AUTHOR  HOWARD W J
TITLE  OPERATION JANGLE. FREE AIR PRESSURE MEASUREMENTS, PROJECT 1.4 (CONTAINED WITHIN DTL-018.851)

WT-308-EX                                                          791001        A U        0187        B951736          800872
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                                AUTHOR  ALLEN P W
TITLE  OPERATION BUSTER, TRANSPORT OF RADIOACTIVE DEBRIS FROM OPERATIONS BUSTER AND JANGLE PROJECT 7.1

WT-309                                                             520429        A U        0051        A995157          018811
ORG-AG FOREST SERVICE                                                      AUTHOR  BROWN A A
TITLE  THERMAL AND BLAST EFFECTS ON IDEALIZED FOREST FUELS, PROJECT 2.2, OPERATION BUSTER
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WT-310                                                                 520317          A U      0033        460275         018810
ORG-AG NATIONAL BUREAU OF STANCARDS                                         AUTHOR  ROBERTSON A F
TITLF  EFFECTS OF GECMETRY CA FLASH THERMAL DAMAGE, PROJECT 2.3, OPERATION BUSTER

WT-311                                                                 000000          A U      0110        483460         018809
ORG-AG NEW YORK NAVAL SHIPYARD                                              AUTHOR  MONAHAN T I
TITLE  EFFECT OF THERMAL RADIATICN ON MATERIALS, OPERATION BUSTER

WT-312                                                                 520626          A U      0096        A995133        018808
ORG-AG QUARTERMASTER CORPS. ARMY                                            AUTHOR  DAVIES J M
TITLE  PROTECTIVE VALUE ANC IGNITICN HAZARDS OF TEXTILE MATERIALS EXPOSED TO THERMAL RADIATION, OPERATION BUSTER

WT-313                                                                 520314          A U      0097        374623         018835
ORG-AG ENGINEER RES AND CEV LABS. ARMY                                      AUTHOR  THURSTOA R D
TITLE  MINEFIELD CLEARANCE

WT-314                                                                 520424          A U      0036        482983         018834
ORG-AG ENGINEER RES AND CEV LABS. ARMY                                      AUTHOR  LINDSTEK D C
TITLE  EFFECTS ON SELECTED WATER SUPPLY EQUIPMENT, OPERATION BUSTER

WT-315                                                                 520501          A U      0027        B950688        018833
ORG-AG NAVAL MEDICAL RES INST                                               AUTHOR  CHAMBERS F W
TITLE  RADIATICN DOSIMETERY

WT-316                                                                 520201          A U      0053        A995134        018832
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                       AUTHOR  SHELINE G E
TITLE  THERMAL EFFECTS CA ANIMALS (RATS), OPERATION BUSTER

WT-317                                                                 520321          A U      0043        A077496        018831
ORG-AG SIGNAL CORPS ENGINAERING LABS. ARMY                                  AUTHOR  CRYDEN J
TITLE  EVALUATION OF DOSIMETRIC MATERIALS

WT-318                                                                 520509          A U      0032        A077497        018830
ORG-AG BUREAU OF AERCNALTICS. NAVY                                          AUTHOR  TERRY J H
TITLE  AIRBORNE RACIAC EVALLATION


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WT-319                                                 520200       A U       0073       A999155        018829
ORG-AG SIGNAL CORPS. ARMY                                    AUTHOR  STANFORC L H
TITLE  EFFECTS OF ATOMIC DETONATIONS ON RADIO PROPAGATION, PROJECT 6.9, OPERATION BUSTER

WT-320-EX                                              791001       A U       0023       A995009        801038
ORG-AG OFFICE FOR ATOMIC ENERGY. AF                          AUTHOR  SINGLEVICH W
TITLE  OPERATION BUSTER JANGLE, RADIOCHEMICAL, CHEMICAL, AND PHYSICAL ANALYSIS OF ATOMIC BOMB DEBRIS, PROJECT 7.3 (BUSTER), PRO
       JECT 7.1 (JANGLE), EXTRACTED VERSION

WT-321.                                                520315       A U       0062       374648         018827
ORG-AG AIR FORCE                                             AUTHOR  CROCKER J A
TITLE  SEISMIC WAVES FROM A-BOMBS DETONATED OVER A LAND MASS, PROJECT 7.2 AND PROJECT 7.5, OPERATION BUSTER JANGLE

WT-322                                                 520315       A U       0147       A995156        018826
ORG-AG AIR FORCE                                             AUTHOR  OLMSTED G B
TITLE  DETECTION OF AIRBORNE LOW-FREQUENCY SOUND FROM THE ATOMIC EXPLOSIONS OF BUSTER AND JANGLE, PROJECT 7.6 AND PROJECT 7.3,
       OPERATION BUSTER JANGLE

WT-324                                                 520523       A U       0227       A078577        095055
ORG-AG BROOKHAVEN NATIONAL LAB                               AUTHOR  RANKOWITZ S
TITLE  OPERATION JANGLE, FREE AIR SHOCK ARRIVAL TIMES, PROJECT 1.3A (CONTAINED WITHIN DTL-018,851)

WT-325                                                 520410       A U       0227       A078577        095057
ORG-AG CAMBRIDGE RES CENTER. AF                              AUTHOR  HASKELL N A
TITLE  OPERATION JANGLE, THE MEASUREMENT OF FREE AIR ATOMIC BLAST PRESSURES, PROJECT 1.3C (CONTAINED WITHIN DTL-018,851)

WT-327                                                 510721       A U       0051       801299         018825
ORG-AG UNITED GEOPHYSICAL CO                                 AUTHOR  RUGG A P
TITLE  SEISMIC REFRACTION SURVEY FOR NYE COUNTY, NEVADA, PROJECT 1(B)A-1, OPERATION JANGLE

WT-329                                                 520401       A U       0339       A078575        095044
ORG-AG NATIONAL BUREAU OF STANDARDS                          AUTHOR  COSTRELL L
TITLE  GAMMA RADIATION AS A FUNCTION OF TIME AND DISTANCE, OPERATION JANGLE (CONTAINED WITHIN WT-370)
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WT-330                                                             520600         A U        0339       A078575         095046
ORG-AG TECHNICAL APPLICATIONS CENTER. AF                                  AUTHOR  HARLAN W E
TITLE  AERIAL SURVEY OF DISTANT CONTAMINATED TERRAIN, OPERATION JANGLE (CONTAINED WITHIN WT-370)

WT-331                                                             520315         A U        0339       A078575         095049
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                                AUTHOR  FORBES M B
TITLE  TOTAL DOSAGE, OPERATION JANGLE (CONTAINED WITHIN WT-370)

WT-332                                                             520500         A U        0241       611250          095025
ORG-AG NAVAL MEDICAL RES INST                                             AUTHOR  CHAMBERS F W
TITLE  GAMMA DEPTH DOSE MEASUREMENT IN UNIT DENSITY MATERIAL, OPERATION JANGLE (CONTAINED WITHIN WT-372)

WT-333-EX                                                          791001         A U        0417       A995072         095065
ORG-AG MEDICAL SERVICE GRADUATE SCHOOL. ARMY                              AUTHOR  MAXWELL R D
TITLE  RADIOCHEMICAL STUDIES OF LARGE PARTICLES, OPERATION JANGLE, EXTRACTED VERSION  (CONTAINED WITHIN WT-371-EX)

WT-334-EX                                                          791001         A U        0263       A995013         095062
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                                AUTHOR  FORBES M B
TITLE  REMOTELY CONTROLLED SAMPLING TECHNIQUES, OPERATION JANGLE, EXTRACTED VERSION (CONTAINED WITHIN WT-373-EX)

WT-335-EX                                                          791001         A U        0417       A995072         095066
ORG-AG DEPARTMENT OF AGRICULTURE                                          AUTHOR  ALEXANDER L T
TITLE  ANALYSIS OF TEST SITE AND FALLOUT MATERIAL, OPERATION JANGLE, EXTRACTED VERSION (CONTAINED WITHIN WT-371-EX)

WT-336                                                             520200         A U        0053       801300          018824
ORG-AG NAVAL CIVIL ENGINEERING LAB                                        AUTHOR  BISHOP J A
TITLE  ENGINEER SOIL MECHANICS TESTS, OPERATION BUSTER JANGLE

WT-337                                                             520512         A U        0061       A995160         018823
ORG-AG SIGNAL CORPS. ARMY                                                 AUTHOR  FORBES M B
TITLE  EVALUATION OF MILITARY RADIAC EQUIPMENT, OPERATION JANGLE, PROJECT 6.1

WT-338                                                             520500         A U        0049       629883          018822
ORG-AG STANFORD RES INST                                                  AUTHOR  VAILE R B
TITLE  EVALUATION OF FISSILE HAZARD, UNDERGROUND SHOT, OPERATION JANGLE, PROJECT 4.5

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                                                  BUSTER JANGLE    1951

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WT-342                                                                      511231        A U       0263       A995159        018819
ORG-AG  AIR WEATHER SERVIC[illegible]                                                AUTHOR  KARSTENS E H
TITLE   AIR WEATHER SERVIC[illegible]ATION IN OPERATION BUSTER, PRCJECT 8.2, OPERATICN BUSTER

WT-343                                                                      520500        A U       0075       A995158        018848
ORG-AG  GEOLOGICA[illegible]                                                         AUTHOR  PIPER A P
TITLE   GEOLOGIC [illegible]L FEATURES OF THE SITES, PROJECT 1(8)A, OPERATIONS WINDSTORM AND JANGLE

WT-344                                                                      520314        A U       0056       A995164        018847
CRG-AG  WRIGHT AIR [illegible] DIV. AF                                               AUTHOR  JAMES F E
TITLE   OPERATICNAL [illegible] OF TECHNIGUES FCR ACCOMPLISHING INDIRECT BOMB DAMAGE ASSESSMENT, PROJECT 6.5 AND PROJECT 6.4, OPERATIO
        N BUSTER JAN[illegible]

WT-345                                                                      520400        A U       0241       611250         095024
ORG-AG  NAVAL RADIOLOGICAL DEFENSE LAB                                               AUTHOR  TOCHILIN E
TITLE   BETA RAY AND GAMMA RAY ENERGY OF RESIDUAL CONTAMINATION, OPERATION JANGLE (CONTAINED WITHIN WT-372)

WT-348                                                                      520624        A U       0241       611250         095026
ORG-AG  BROOKHAVEN NATIONAL LAB                                                      AUTHOR  BERNSTEIN W
TITLE   GAMMA RAY SPECTRUP MEASUREMENTS CF RESIDUAL RADIATION, OPERATION JANGLE (CONTAINED WITHIN WT-372)

WT-351                                                                      000000        A U       0339       A078575        095047
ORG-AG  BUREAU OF AERCNALTICS                                                        AUTHOR  TERRY J H
TITLE   AERIAL SURVEY OF LOCAL CCNTAMINATED TERRAIN, OPERATION JANGLE (CONTAINED WITHIN WT-370)

WT-356                                                                      520600        A U       0037       A995063        018841
ORG-AG  LOS ALAMOS SCIENTIFIC LAB                                                    AUTHOR  MALIK J S
TITLE   MEASUREMENT OF GAMMA RAY INTENSITY VS TIME

WT-363-EX                                                                   791001        A U       0263       A995013        095061
ORG-AG  NATICNAL INST OF HEALTH                                                      AUTHOR  MAXWELL C R
TITLE   RETRIEVABLE MISSILES FCR REMOTE GROUND SAMPLING, OPERATION JANGLE, EXTRACTED VERSION (CONTAINED WITHIN WT-373-EX)

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WT-364                                                 520300        A U        0227       A078577         095054
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                  AUTHOR  GANNON W F
TITLE  OPERATION JANGLE, CLCSE-IN GROUND MEASUREMENTS, PROJECT 1.2B (CONTAINED WITHIN DTL-018,851)

WT-365                                                 520400        A U        0323       A995025         018853
ORG-AG STANFORD RES INST                                     AUTHOR  DOLL E B
TITLE  HIGH EXPLOSIVE TESTS

WT-366                                                 520600        A U        0417       B952222         018852
ORG-AG CEFENSE ATOMIC SUPPORT AGENCY                         AUTHOR  MORRIS W E
TITLE  BLAST AND SHOCK MEASUREMENTS I, OPERATION JANGLE

WT-367                                                 000000        A U        0231       A078577         018851
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                  AUTHOR
TITLE  BLAST AND SHCCK MEASUREMENTS II

WT-368                                                 511101        A U        0381       636413          018850
ORG-AG NAVAL ORDNANCE LAB                                    AUTHOR
TITLE  BLAST AND SHOCK MEASUREMENTS 3

WT-369                                                 520400        A U        0187       608885          018857
ORG-AG CALIFORNIA, UNIV                                      AUTHOR  MOOREY C B
TITLE  THEORETICAL STUDIES OF UNCERGROUND SHOCK WAVES, PROJECT 1.9, OPERATION JANGLE

WT-370                                                 520401        A U        0339       A078575         018856
ORG-AG DEFENSE ATOMIC SUPPCRT AGENCY                         AUTHOR  COSTRELL L
TITLE  GAMMA RADIATICN MEASUREMENTS

WT-371-EX                                              791001        A U        0417       A995072         801424
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                  AUTHOR  ROBBINS C
TITLE  OPERATION JANGLE, PARTICLE STUDIES, EXTRACTED VERSION

WT-372                                                 520400        A U        0241       611250          018854
ORG-AG DEFENSE ATOMIC SUPPCRT AGENCY                         AUTHOR  HOWLAND P R
TITLE  BIOLOGICAL HAZARCS
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WT-373-EX                                                             791001        A U       0263      A995013        801155
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                                  AUTHOR  MAXWELL C R
TITLE  OPERATION JANGLE, RADIOCHEMICAL MEASUREMENTS AND SAMPLING TECHNIQUES, EXTRACTED VERSION

WT-376                                                                520700        A U       0233      B951596        018861
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY                                         AUTHOR  HENDRICKSON J R
TITLE  TESTS OF SERVICE EQUIPMENT IN OPERATION

WT-380                                                                520400        A U       0099      A995076        741058
ORG-AG STANFORD RES INST                                                     AUTHOR  DOLL E E
TITLE  GROUND ACCELERATION, GROUND AND AIR PRESSURES FOR UNDERGROUND TESTS, OPERATION JANGLE

WT-381                                                                520522        A U       0033      454866         018858
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY                                         AUTHOR  JOHNSON G W
TITLE  MONITOR SURVEY OF GROUND CONTAMINATION (RADSAFE)

WT-381                                                                520522        A U       0339      A078575        095048
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                                  AUTHOR  JOHNSON G W
TITLE  MONITOR SURVEY OF GROUND CONTAMINATION (RADSAFE), OPERATION JANGLE (CONTAINED WITHIN WT-370)

WT-383                                                                520515        A U       0077      370259         018874
ORG-AG ENGINEER RES AND DEV LABS. ARMY                                       AUTHOR  WALSH T G
TITLE  PROTECTIVE EFFECTS OF FIELD FORTIFICATIONS AGAINST NEUTRON AND GAMMA RAY FLUX

WT-386-EX                                                             791001        A U       0263      A995013        095059
ORG-AG NATIONAL INST OF HEALTH                                               AUTHOR  MAXWELL C R
TITLE  NATURE AND DISTRIBUTION OF RESIDUAL CONTAMINATION I. OPERATION JANGLE, EXTRACTED VERSION

WT-389                                                                520600        A U       0227      A078577        095056
ORG-AG NAVAL ORDNANCE LAB                                                    AUTHOR  MOULTON J F
TITLE  OPERATION JANGLE, PEAK PRESSURE VS DISTANCE IN FREE AIR USING SMOKE ROCKET PHOTOGRAPHY, PROJECT 1.3B (CONTAINED WITHIN D
       TL-018,851)
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      PRI-RPT                          SEC-RPT                ORG-DT     H-CLASS    PG-LF      DOC-AD-NO       DTL-NO

WT-392                                                        520430        A U      0339      A078575         095045
ORG-AG BUREAU OF AERONAUTICS                                          AUTHOR  TERRY J H
TITLE  GAMMA RADIATION AS A FUNCTION OF TIME WITH DROPPABLE TELEMETERS, OPERATION JANGLE (CONTAINED WITHIN WT-370)

WT-393                                                        520627        A U      0339      A078575         095050
ORG-AG ENGINEER RES AND DEVELOPMENT LABS. ARMY                        AUTHOR  WALSH T G
TITLE  FOXHOLE SHIELDING OF GAMMA RADIATION, OPERATION JANGLE (CONTAINED WITHIN WT-370)

WT-394-EX                                                     791001        A U      0417      A995072         095063
ORG-AG CHEMICAL AND RADIOLOGICAL LABS. ARMY                           AUTHOR  ROBBINS C
TITLE  AIRBORNE PARTICLE STUDIES, OPERATION JANGLE, EXTRACTED VERSION (CONTAINED WITHIN WT-371-EX)

WT-395-EX                                                     791001        A U      0417      A995072         095064
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                 AUTHOR  POPPOFF I G
TITLE  FALLOUT PARTICLE STUDIES, OPERATION JANGLE, EXTRACTED VERSION (CONTAINED WITHIN WT-371-EX)

WT-396                                                        520618        A U      0241      611250          095027
ORG-AG NATIONAL INST OF HEALTH                                        AUTHOR  SMITH F
TITLE  BIOLOGICAL INJURY FROM PARTICLE INHALATION, OPERATION JANGLE (CONTAINED WITHIN WT-372)

WT-397-EX                                                     791001        A U      0263      A995013         095060
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                 AUTHOR  BALLOU N E
TITLE  NATURE AND DISTRIBUTION OF RESIDUAL CONTAMINATION 2, OPERATION JANGLE, EXTRACTED VERSION (CONTAINED WITHIN WT-373-EX)

WT-414-EX                                                     791001        A U      0153      A995000         800983
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                           AUTHOR  GEORGE P S
TITLE  OPERATION JANGLE, SUMMARY REPORT, WEAPON EFFECTS TESTS, EXTRACTED VERSION

WT-425-EX                                                     791001        A U      0064      B951743         800963
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                      AUTHOR  SHIPMAN T L
TITLE  OPERATION BUSTER JANGLE, RADIOLOGICAL SAFETY, EXTRACTED VERSION
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JTF-3                                                                    510000        A U         0010       A078576         018796
ORG-AG JOINT TASK FORCE 3                                                     AUTHOR
TITLE  CPERATICN GREENHCLSE

WT-111-EX                                                                791001        A U         0028       A995012         801122
ORG-AG ATOMIC ENERGY COMPISSION                                               AUTHOR
TITLE  OPERATICN GREENHCUSE, VCLUME 2 - SCIENTIFIC DIRECTORS REPORT, PART 3 - EVALLATION OF PROGRAMS 3 TO 6 AND 8, EXTRACTED VE
       RSION

WT-117-EX                                                                800201        A U         0112       B951735         800871
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                                   AUTHOR
TITLE  OPERATION GREENHOUSE, SCIENTIFIC DIRECTORS REPORT, ANNEX 3.0, THE TEST OF STRUCTURES, EXTRACTED VERSION

WT-21-EX                                                                 791001        A U         0172       A995028         801441
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                              AUTHOR  GRAVES A C
TITLE  OPERATICN GREENHOUSE, VOLUME 2 - SCIENTIFIC DIRECTORS REPORT, PART 2 - EVALLATION OF PROGRAM 2, EXTRACTED VERSION

WT-46-EX                                                                 810801        A U         0075       A995115         811167
ORG-AG JOINT TASK FORCE 3                                                     AUTHOR  PATE E W
TITLE  OPERATICN GREENHCLSE, MET.CROLOGICAL TECHNICAL REPORT, EXTRACTED VERSION

WT-65                                                                    510700        A U         0234       B951671         018736
ORG-AG WRIGHT AIR DEVELCPMENT CENTER                                          AUTHOR  GRIMES CAVID L
TITLE  EFFECTS OF AN ATCMIC BOMB BURST ON AIRCRAFT STRUCTURES ON   THE GROUND

WT-89                                                                    510700        A U         0074       A080271         018754
ORG-AG ATOMIC ENERGY COMMISSION                                               AUTHOR
TITLE  SCIENTIFIC DIRECTCRS REPORT, ANNEX 9.3, RADIOLOGICAL SAFETY

WT-90                                                                    520800       A  U         0290       374634          021254
ORG-AG BALLISTIC RES LABS. ARMY                                               AUTHOR  BERNING W W
TITLE  COMBAT VEHICLE EXPOSURE


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JRB-2-816-03-423-00         DNA-6022F                    820226        A U         0182      A118684         820689
ORG-AG JRB ASSOCIATES                                         AUTHOR  MAAG C
TITLE  CPERATION RANGER, SHCTS ABLE, BAKER, EASY, BAKER-2, FOX, 25 JANUARY - 6 FEBRUARY 1951

WT-201                                                   510200        A U         0267      A995162         018807
ORG-AG LOS ALAMOS SCIENTIFIC LAB                              AUTHOR
TITLE  CPERATION RANGER, VOLUME 4 - PROGRAM REPORTS, GROSS WEAPONS MEASUREMENTS

WT-202-EX                                                800201        A U         0105      A995032         801491
CRG-AG LOS ALAMOS SCIENTIFIC LAB                              AUTHOR
TITLF  OPERATICN RANGER, VOLUME 2 - HANDBOOK FOR OPERATION RANGER AND A SUMMARY OF TEST RESULTS, EXTRACTED VERSION

WT-203-EX                                                800201        A U         0183      A995101         810801
ORG-AG LOS ALAMOS SCIENTFIC LAB                               AUTHOR
TITLF  OPERATION RANGER, VOLUME 3 - PROGRAM REPORT, WEAPONS DEVELOPMENT, EXTRACTED VERSION

WT-204-V-5                                               520700        A U         0104      A995163         018804
ORG-AG LOS ALAMOS SCIENTIFIC LAB                              AUTHOR
TITLE  OPERATICN RANGER, VOLUME 5 - PROGRAM REPORTS, OPERATIONAL

WT-205                                                   520700        A U         0057      A078580         018803
ORG-AG LOS ALAMOS SCIENTIFIC LAB                              AUTHOR  TYLER C L
TITLE  OPERATION RANGER, NEVADA TEST SITE, JAN - FEB 1951, VOLUME 6 - ADMINISTRATIVE SUMMARY REPORT

WT-206-EX                                                791001        A U         0071      A995073         801558
ORG-AG LOS ALAMOS SCIENTIFIC LAB                              AUTHOR  CLARK J C
TITLE  OPERATION RANGER, VCLLME 1 - REPORT OF THE DEPUTY TEST DIRECTOR, EXTRACTED VERSION



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JTF-132                                                                 820801          A U       0277       A995172          830001
ORG-AG  JOINT TASK FORCE 132                                                   AUTHOR  CLARKSON P W
TITLE   OPERATION IVY COMMUNICATIONS, EXTRACTED VERSION

WT-605                                                                  530400          A U       0024       341048           018991
ORG-AG  SANDIA CORP                                                            AUTHOR  ROLLOSSON G W
TITLE   OPERATION IVY, UNDERWATER PRESSURE MEASUREMENTS IN THE LAGOON

WT-614                                                                  530100          A U       0108       363620           018998
ORG-AG  LOS ALAMOS SCIENTIFIC LABORATORY                                       AUTHOR  MAYNARD R H
TITLE   RADIOLOGICAL SAFETY

WT-631                                                                  530800          A U       0051       363575           019018
ORG-AG  CAMBRIDGE RES CENTER. AF                                               AUTHOR  HASKELL N A
TITLE   FREE AIR ATOMIC BLAST PRESSURE AND THERMAL MEASUREMENTS, OPERATION IVY

WT-635                                                                  530600            U       0040       363623           019014
ORG-AG  SCIRPPS INSTITUTION OF OCEANOGRAPHY                                    AUTHOR  BASCOM W
TITLE   BAROMETRIC AND WATER SURFACE WAVES PRODUCED BY MIKE SHOT, REPORT TO THE SCIENTIFIC DIRECTOR, OPERATION IVY

WT-642                                                                  540800          A U       0064       363391           019033
ORG-AG  SIGNAL CORPS ENGINEERING LABS. ARMY                                    AUTHOR  DANIELS F B
TITLE   EFFECTS OF ATOMIC EXPLOSIONS ON THE IONOSPHERE, REPORT TO THE SCIENTIFIC DIRECTOR, OPERATION IVY

WT-649                                                                  580100          A U       0016       467226           019026
ORG-AG  LIVERMORE RADIATION LAB                                                AUTHOR  KLEIN M F
TITLE   FALLOUT GAMMA RAY INTENSITY

WT-9002-EX                                                              811101          A U       0056       A995143          820572
ORG-AG  SANDIA CORP                                                            AUTHOR  PERRET W R
TITLE   GENERAL REPORT OF WEAPONS TESTS, GROUND MOTION STUDIES ON OPERATIONS IVY AND CASTLE, EXTRACTED VERSION

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        PRI-RPT                          SEC-RPT                ORG-DT      H-CLASS      PG-LF      DDC-AD-NO      DTL-NO
ARMY 6TH
ORG-AG 6TH. ARMY                                                520000        A U        0236       A078565        007438
TITLE  EXERCISE DESERT RECK 4, APRIL - JUNE 1952                    AUTHOR

HUMRRO
ORG-AG GEORGE WASHINGTON UNIV, HUMAN RESOURCES RES OFFICE       531101        A U        0022       482185         007437
TITLE  CHARACTERISTICS CF TRCOPS WITH VARYING LEVELS OF INFORMATION ABOUT  AUTHOR
                                                                        ATOMIC EFFECTS, DESERT ROCK 4
HUMRRO
ORG-AG GEORGE WASHINGTOA UNIV                                   540300        A U        0018       482184         007465
TITLE  GAIN IN INFORMATICN IA THE DESERT ROCK A-BOMB MANEUVERS      AUTHOR  WINOGRAD B

HUMRRO-TR-2
ORG-AG GEORGE WASHINGTOA UNIV, HUPAN RESOURCES RES OFFICE       530801        A U        0225       016451         007443
TITLE  DESERT ROCK FOUR - REACTICNS OF AN ARMORED INFANTRY BATTALION  AUTHOR
                                                                 TO AN ATOMIC BOMB MANEUVER
JRB-2-816-03-423-00           CNA-6021F                        820616        A U        0178       A122240        821202
CRG-AG JRB ASSOCIATES                                               AUTHOR  PONTON J
TITLE  SHOTS EASY, FCX, GEORGE AND HOW, THE FINAL TESTS OF TUMBLER SNAPPER SERIES, 7 MAY - 5 JUNE 1952

JRB-2-816-03-423-00           DNA-6020F                        820615        A U        0232       A122241        821133
ORG-AG JRB ASSOCIATES                                               AUTHOR  PONTON J
TITLE  SHOTS ABLE, BAKER, CHARLIE, AND DOG, THE FIRST SERIES OF THE TUMBLER SNAPPER SERIES, 1 APRIL-1 MAY 1952

JRB-2-816-03-423-00           CNA-6019F                        820614        A U        0218       A122242        821143
ORG-AG JRB ASSOCIATES                                               AUTHOR  PONTON J
TITLE  OPERATION TUMBLER SNAPPER, 1952

ORO-T-240
ORG-AG JOHN HOPKINS UNIV                                        530715        A U        0116       026280         740975
TITLE  REACTICNS OF TROCPS IA ATCMIC MANEUVERS, EXERCISE DESERT ROCK 4  AUTHOR  BILLINGSLEY S O

WT-508
ORG-AG AIR WEATHER SERVICE. AF                                  530100          U        0077       A995045        018907
TITLE  AIR WEATHER SERVICE PARTICIPATION                            AUTHOR  KARSTENS E H


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           PRI-RPT                   SEC-RPT               ORG-DT     H-CLASS      PG-LF      DOC-AD-NO      DTL-NO

WT-511                                                     520601        A U        0059     A078574          018904
ORG-AG CAMBRIDGE RES CTR, OPERATIONAL APPLICATIONS LAB. A       AUTHOR  HASKELL N A
TITLE  MEASUREMENT OF FREE AIR ATOMIC BLAST PRESSURES

WT-513-EX                                                  800301        A U        0254     A995029          801472
ORG-AG NAVAL ORDNANCE LAB                                       AUTHOR  ARONSON C J
TITLE  OPERATION TUMBLER, PROJECTS 1.3 AND 1.5, FREE AIR AND GROUND LEVEL PRESSURE MEASUREMENTS, EXTRACTED VERSION

WT-514-EX                                                  800201        A U        0125     A995015          801156
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                     AUTHOR  SCOVILLE H
TITLE  OPERATION TUMBLER FINAL SUMMARY REPORT, EXTRACTED VERSION

WT-515                                                     521200        A U        0075     A078547          018919
ORG-AG BALLISTIC RES LABS. ARMY                                 AUTHOR
TITLE  AIR BLAST MEASUREMENTS

WT-516                                                     520601        A U        0051     483928           018918
ORG-AG BALLISTIC RES LABS. ARMY                                 AUTHOR  FISCHER J J
TITLE  GROUND ACCELERATION MEASUREMENTS'

WT-519                                                     521000        A U        0095     A078549          018929
ORG-AG CHEMICAL AND RADIOLOGICAL LABS                           AUTHOR  BOUTON E H
TITLE  PRE-SHOCK DUST, PROJECT 1.9

WT-521                                                     530301        A U        0071     A078546          018927
ORG-AG DAVID TAYLOR MODEL BASIN. NAVY                           AUTHOR  COOK G W
TITLE  MEASUREMENT OF AIR BLAST PRESSURE VS TIME

WT-522                                                     520601        A U        0045     A077502          018926
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                      AUTHOR  LARRICK R G
TITLE  TOTAL GAMMA EXPOSURE VS DISTANCE

WT-523                                                     530201        A U        0039     460277           018925
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                      AUTHOR  UNGAR S H
TITLE  GAMMA RAY ENERGY SPECTRUM OF RESIDUAL CONTAMINATION
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    PRI-RPT                      SEC-RPT          ORG-DT     H-CLASS      PG-LF     DOC-AD-NO        DTL-NO

WT-524-EX                                         800201       A U        0053      A995033          801495
ORG-AG NAVAL RES LAB                                     AUTHOR
TITLE  OPERATION SNAPPER, PROJECT 2.3, NEUTRON FLUX MEASUREMENTS, EXTRACTED VERSION

WT-525                                            530200       A U        0493      A995050          018940
ORG-AG WRIGHT AIR DEVELOPMENT DIV  AF                    AUTHOR  SCHRAUT K C
TITLE  VULNERABILITY OF PARKED AIRCRAFT TO ATOMIC BOMBS

WT-526                                            530200       A U        0073      A995044          018939
ORG-AG ENGINEER RESEARCH AND DEVELOPMENT LAB             AUTHOR  RICHMOND D
TITLE  MINEFIELD CLEARANCE, OPERATION SNAPPER, PROJECT 3.4

WT-527                                            521200       A U        0081      A078564          018938
ORG-AG NAVAL MEDICAL RESEARCH INSTITUTE                  AUTHOR  DRAEGER R H
TITLE  BIOMEDICAL EXPOSURE EQUIPMENT

WT-528-EX                                         800201       A U        0090      A995016          801153
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT              AUTHOR
TITLE  OPERATION SNAPPER, PROJECT 4.3, THE BIOLOGICAL EFFECTIVENESS OF NEUTRON RADIATION FROM NUCLEAR WEAPONS, EXTRACTED VERSIO
       N

WT-529                                            530200       A U        0043      B950689          018936
ORG-AG NAVAL MEDICAL RES INST                            AUTHOR  CHAMBERS F W
TITLE  GAMMA DEPTH DOSE MEASUREMENT IN UNIT DENSITY MATERIAL

WT-530                                            530300       A U        0033      A078548          018935
ORG-AG SCHOOL OF AVIATION MEDICINE, AF                   AUTHOR  BYRNES V A
TITLE  FLASH BLINDNESS

WT-532                                            530100       A U        0077      A077498          018933
ORG-AG BUREAU OF SHIPS, NAVY                             AUTHOR  SISK F J
TITLE  EVALUATION OF MILITARY RADIAC EQUIPMENT
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     PRI-RPT                    SEC-RPT                ORG-DT     H-CLASS    PG-LF     DDC-AD-NO     DTL-NO

WT-533                                                 521100       A U       0073     B951597       018932
ORG-AG CHEMICAL AND RADIOLOGICAL LABS. ARMY                   AUTHOR  ORT F G
TITLE  EVALUATION OF A FILTRATION SYSTEM FOR PRESSURIZED AIRCRAFT

WT-534                                                 510821       A U       0054     A080269       018931
ORG-AG WRIGHT AIR DEVELOPMENT CENTER                          AUTHOR  BOONE HARRY F
TITLE  OPERATIONAL TESTS OF RADAR AND PHOTOGRAPHIC TECHNIQUES FOR  IBDA

WT-535                                                 530301       A U       0069     A995023       018952
ORG-AG WRIGHT AIR DEVELOPMENT DIV. AF                         AUTHOR  TERF J
TITLE  DECONTAMINATION OF AIRCRAFT

WT-536                                                 521100       A U       0061     A077499       018951
ORG-AG CHEMICAL AND RADIOLOGICAL LABS. ARMY                   AUTHOR  HARDIN L M
TITLE  EVALUATION OF AIR MONITORING INSTRUMENTS

WT-537-EX                                              800201       A U       0057     B951763       800954
ORG-AG DEPARTMENT OF THE AIR FORCE                            AUTHOR  OLESON M H
TITLE  OPERATION SNAPPER, PROJECT 7.1A, ELECTROMAGNETIC EFFECTS FROM ATOMIC EXPLOSIONS, EXTRACTED VERSION

WT-539-EX                                              800201       A U       0034     B951746       800966
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                   AUTHOR
TITLE  OPERATION TUMBLER SNAPPER, PROJECT 7.2, DETECTION OF AIRBORNE LOW FREQUENCY SOUND FROM ATOMIC EXPLOSIONS, EXTRACTED VERS
       ION

WT-542                                                 520901       A U       0083     483422        018945
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                         AUTHOR  BROIDA T R
TITLE  AIR TEMPERATURES IN THE VICINITY OF A NUCLEAR DETONATION

WT-543                                                 530300       A U       0109     B951585       018944
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                         AUTHOR  BROIDO A
TITLE  THERMAL RADIATION FROM A NUCLEAR DETONATION
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WT-544                                                                  530200        A U        0023       B951586        018943
ORG-AG NEW YORK NAVAL SHIPYARD MATERIAL LAB                                  AUTHOR  BANET L
TITLE  THERMAL RADIATION MEASURUEMENTS USING PASSIVE INDICATORS

WT-545                                                                  530100        A U        0045       460278         018942
ORG-AG NEW YORK NAVAL SHIPYARD MATERIAL LAB                                  AUTHOR  DERSKEN W L
TITLE  ATMOSPHERIC TRANSMISSICN AND WEATHER MEASLREMENTS

WT-552                                                                  521100        A U        0064       A076362        018957
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                             AUTHOR  SPOHN C A
TITLE  ACTIVITIES OF THE SPECIAL WEATHER ADVISORY SERVICE

WT-553                                                                  540100        A U        0054       A077500        018956
ORG-AG LOS ALAMCS SCIENTIFIC LAB                                             AUTHOR
TITLE  STAFF REPORTS OPERATICN TUMBLER-SNAPPER

WT-555-EX                                                               791001        A U        0079       B951747        800956
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                             AUTHOR  COWEN C L
TITLE  OPERATICN TUMBLER SNAPPER, EXTERNAL NEUTRCN MEASUREMENTS, PROJECTS 17.1 AND 17.2, EXTRACTED VERSION

WT-558-EX                                                               800201        A U        0334       A995071        801423
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                                  AUTHOR
TITLE  OPERATION TUMBLER SNAPPER RADIOLOGICAL SAFETY, EXTRACTED VERSION

WT-564-EX                                                               791001        A U        0048       B951764        800967
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                                  AUTHOR  PAGE G B
TITLE  OPERATION SNAPPER, FINAL REPORT, EXTRACTEC VERSION

WT-566                                                                  530600        A U        0123       A078573        018980
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                             AUTHOR  JOHNSON W S
TITLE  REPORT OF THF ADVISCRY PERSCNNEL TO THE AIR SAMPLING PROGRAM

WT-569                                                                  540400        A U        0155       A995066        018977
ORG-AG EG AND G, INC.                                                        AUTHOR  GRIER H
TITLE  TECHNICAL PHOTOGRAPHY, REPORT TO THE TEST DIRECTOR

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        PRI-RPT                          SEC-RPT                ORG-DT       H-CLASS      PG-LF      DOC-AD-NO       DTL-NO

AFFHRU                                                          530801        A U         0033        478053         110886
ORG-AG HUMAN RESOURCES RES ORGANIZATION                             AUTHOR  WHITE B W
TITLE  DESERT ROCK 5, REACTIONS OF TROOP PARTICIPANTS AND FORWARD VOLUNTEER OFFICER GROUPS TO ATOMIC EXERCISES

ARMY 6TH CORP                                                   530716        A U         0198       A078559         007447
ORG-AG DEPARTMENT OF THE ARMY                                       AUTHOR
TITLE  EXERCISE DESERT ROCK 5, VOLUME 1 - OPERATIONS

ARMY 6TH CORP                                                   530526        A U         0088       A078555         007444
ORG-AG QUARTERMASTER RES AND DEV LABS. ARMY                         AUTHOR  DAVIES J M
TITLE  OPERATION SNAPPER, TEST CONDUCTED AS PART OF EXERCISE DESERT ROCK 4, MAY-JUNE 1952, THE SUSCEPTIBILITY TO DAMAGE AND THE
         PROTECTION AFFORDED BY QUARTERMASTER ITEMS

DESERT-ROCK                                                     530418        A U         0098       A078553         007450
ORG-AG MARINE CORPS                                                 AUTHOR
TITLE  ANNEX ABLE TO EXERCISE DESERT ROCK, PHOTOGRAPHIC SUPPLEMENT, EFFECTS OF ATOMIC EXPLOSION ON EQUIPMENT AND CLOTHING

DESERT-ROCK-5                                                   530618        A U         0084       B951589         007448
ORG-AG MARINE CORPS BASE                                            AUTHOR
TITLE  HELICOPTER PARTICIPATION IN EXERCISE DESERT ROCK 5, REPORT OF

DESERT-ROCK-5                                                   531030        A U         0081       A078567         007449
ORG-AG MARINE CORPS BASE                                            AUTHOR
TITLE  EXERCISE DESERT ROCK 5, MARINE CORPS, REPORT ON

JRB-2-816-03-423-00           DNA-6015F                         820112        A U         0100       A121671         821006
ORG-AG JRB ASSOCIATES                                               AUTHOR  MASSIE J
TITLE  SHOT BADGER, A TEST OF THE UPSHOT KNOTHOLE SERIES, 18 APRIL 1953

JRB-2-816-03-423-00           DNA-6014F                         820111        A U         0266       A121624         821005
ORG-AG JRB ASSOCIATES                                               AUTHOR  PONTON J
TITLE  OPERATION UPSHOT-KNOTHOLE, 1953

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        PRI-RPT                          SEC-RPT                  ORG-DT      H-CLASS      PG-LF       DDC-AD-NO         DTL-NO

JRB-2-816-03-423-00             DNA-6017F                         820114        A U        0208       A121635            821046
ORG-AG JRB ASSOCIATES                                                    AUTHOR  MASSIE J
TITLE  SHOTS ANNIE TO RAY, THE FIRST FIVE TESTS OF THE UPSHOT KNOTHOLE SERIES, 17 MARCH - 11 APRIL 1953

JRB-2-816-03-423-00             DNA-6018F                         820115        A U        0232       A121634            821047
ORG-AG JRB ASSOCIATES                                                    AUTHOR  MASSIE J
TITLE  SHOTS ENCORE TO CLIMAX, THE FINAL FOUR TESTS OF THE UPSHOT KNOTHOLE SERIES, 8 MAY - 4 JUNE 1953

JRB-2-816-03-423-00             DNA-6016F                         820113        A U        0094       A121667            821045
ORG-AG JRB ASSOCIATES                                                    AUTHOR  MASSIE J
TITLE  SHOT SIMON, A TEST OF THE UPSHOT KNOTHOLE SERIES, 25 APRIL 1953

SAI-82-458-WA                   DNA-5742F                         810428        A U        0124       A116921            820755
ORG-AG SCIENCE APPLICATIONS INC                                          AUTHOR  GOETZ J
TITLE  ANALYSIS OF RADIATION EXPOSURE FOR TROOP OBSERVERS, EXERCISE DESERT ROCK 5, OPERATION UPSHOT KNOTHOLE, FINAL REPORT FOR
       1 MARCH 1980 - 28 APRIL 1981

SAI-82-685-WA                   CAA-TR-82-03                      820205        A U        0054       A124279            830174
ORG-AG SCIENCE APPLICATIONS INC                                          AUTHOR  FRANK G
TITLE  ANALYSIS OF RADIATION EXPOSURE, 2ND MARINE CORPS PROVISIONAL ATOMIC EXERCISE BRIGADE, EXERCISE DESERT ROCK 5, OPERATION
       UPSHOT KNOTHOLE

WADC-TN-55-109                  WT-724                            550500        A U        0182       A073475            019079
ORG-AG AIR MATERIEL COMMAND. AF                                          AUTHOR  SEVIN E
TITLE  TESTS ON THE RESPONSE OF WALL AND ROOF PANELS AND THE TRANSMISSION OF LOAD TO SUPPORTING STRUCTURE

WADC-TR-55-420                  WT-722                            551000          U        0114       A073477            019070
ORG-AG WRIGHT AIR DEVELOPMENT DIV. AF                                    AUTHOR  SEVIN E
TITLE  TESTS ON THE LOADING OF HORIZONTAL CYLINDRICAL SHAPES

WADC-TR-55-421                  WT-723                            551000        A U        0094       A073476            019069
ORG-AG AIR MATERIEL COMMAND. AF                                          AUTHOR  SEVIN E
TITLE  TESTS ON THE LOADING OF TRUSS SYSTEMS COMMON TO OPEN-FRAMED STRUCTURES


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        PRI-RPT                        SEC-RPT                ORG-DT      H-CLASS      PG-LF       DDC-AD-NO        DTL-NO

WT-702-REF                                                    530000         A U        0451      A995148           019059
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                        AUTHOR  COLLISON T D
TITLE  OPERATION UPSHOT KNCTHOLE, RADIOLCGICAL SAFETY OPERATIONS

WT-703                                                        530700         A U        0104      A077506           019058
ORG-AG SPECIAL WEAPONS CENTER. AF                                  AUTHOR  MORGAN D N
TITLE  AIR WEATHER SERVICE PARTICIPATION

WT-705                                                        530700         A U        0098      A077504           019056
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                   AUTHOR  NEWGARDEN G J
TITLE  ACTIVITIES OF THE SPECIAL WEATHER ADVISORY SERVICE

WT-714                                                        540200         A U        0116      A076361           019064
ORG-AG SANDIA LABS                                                 AUTHOR  BROYLES C D
TITLE  DYNAMIC PRESSURE VS TIME AND SUPPORTING AIR BLAST MEASUREMENT

WT-717                                                        560200         A U        0040      357979            019061
ORG-AG CHEMICAL BIOLCGICAL RADICLOGICAL ENG GROUP. ARMY            AUTHOR  CAPASSO N S
TITLE  RADIOACTIVE PARTICLE STUDIES INSIDE AN AIRCRAFT

WT-718                                                        550500         A U        0080      224415            019074
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                         AUTHOR  BASS R C
TITLE  GAMMA RADIATICN SPECTRUM OF RESIDUAL CONTAMINATION

WT-719                                                        570200         A U        0044      338000            019073
ORG-AG NAVAL MEDICAL RES INST                                      AUTHOR  CHAMBERS F W
TITLE  OPERATION UPSHOT KNOTHCLE, PRCJECT 2.28, RESIDUAL IONIZING RADIATION DEPTH DOSE MEASUREMENTS IN UNIT DENSITY MATERIAL

WT-721                                                        550700         A U        0370      A073468           019071
ORG-AG AIR MATERIEL CCMMAND. AF                                    AUTHOR  GALLAGHER E V
TITLE  TESTS ON THE LOADING CF BUILDING AND EQUIPMENT SHAPES

WT-730                                                        540200         A U        0104      357978            019085
ORG-AG ENGINEER RES AND CEVELCPMENT LABS. ARMY                     AUTHOR  RICHMONC D
TITLE  MINEFIELD CLEARANCF, CPERATICN UPSHOT KNOTHOLE


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        PRI-RPT                        SEC-RPT                    ORG-DT      H-CLASS     PG-LF      DOC-AD-NO       DTL-NO

WT-732                                                            000000        A U       0282       357977          019083
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                           AUTHOR   EGGERT J
TITLE  BLAST AND THERMAL EFFECTS OF AN ATOMIC BOMB ON TYPICAL TACTICAL COMMUNICATION SYSTEMS, OPERATION UPSHOT KNOTHOLE

WT-734                                                            540200        A U       0122       370261          019081
ORG-AG ENGINEER RES AND DEVELOPMENT LABS. ARMY                       AUTHOR   MOORE G T
TITLE  EFFECTS OF ENGINEER BRIDGING EQUIPMENT, OPERATION UPSHOT KNOTHOLE

WT-737                                                            540200        A U       0224       482984          019090
ORG-AG BROOKE ARMY MEDICAL CENTER                                    AUTHOR   CHAPMAN E S
TITLE  OPERATION UPSHOT KNOTHOLE, PROJECT 3.27, EFFECTS OF ATOMIC EXPLOSIONS ON FIELD MEDICAL INSTALLATIONS EQUIPMENT

WT-746                                                            531200        A U       0034       460271          019095
ORG-AG MEDICAL SERVICE GRADUATE SCHOOL. ARMY                         AUTHOR
TITLE  BETA GAMMA SKIN HAZARD IN THE POSTSHOT CONTAMINATED AREA

WT-753                                                            550100        A U       0032       A073474         019110
ORG-AG CHEMICAL AND RADIOLOGICAL LABS. ARMY                          AUTHOR   CHANEY J E
TITLE  EVALUATION OF CHEMICAL DOSIMETERS

WT-754                                                            560600        A U       0034       A995147         019109
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                           AUTHOR
TITLE  OPERATION UPSHOT KNOTHOLE, PROJECT 6.7, MEASUREMENTS AND ANALYSIS OF ELECTROMAGNETIC RADIATION FROM NUCLEAR DETONATIONS

WT-755                                                            540600        A U       0090       629545          019108
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                           AUTHOR   JOHNSON J M
TITLE  EVALUATION OF MILITARY RADIAC EQUIPMENT

WT-758                                                            540500          U       0026       A073473         019105
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                           AUTHOR
TITLE  EVALUATION OF RAPID AERIAL RADIOLOGICAL SURVEY TECHNIQUES

WT-759                                                            531200        A U       0046       A951616         019104
ORG-AG TACTICAL AIR COMMAND. AF                                      AUTHOR   CAWLINGS J W
TITLE  INDOCTRINATION OF TACTICAL AIR COMMAND AIR CREWS IN THE DELIVERY AND EFFECTS OF ATOMIC WEAPONS

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         PRI-RPT                                SEC-RPT                ORG-DT       H-CLASS       PG-LF        DDC-AD-NO        DTL-NO

WT-767                                                                 540300          A U        0060         A995146          019116
ORG-AG  CAMBRIDGE RES CTR, OPERATIONAL APPLICATIONS LAB. A                     AUTHOR  BOHN J L
TITLE   OPERATION UPSHOT KNOTHOLE, PROJECT 8.2, MEASUREMENT OF THERMAL RADIATION WITH A VACUUM MICROPHONE

WT-770                                                                 550700          A U        0064         B951673          019132
ORG-AG  QUARTERMASTER RES AND DEV LABS                                         AUTHOR  OESTERLING J F
TITLE   THERMAL RADIATION PROTECTION AFFORDED TEST ANIMALS BY FABRIC ASSEMBLIES, OPERATION UPSHOT-KNOTHOLE, PROJECT 8.5

WT-774                                                                 531200         A U         0040         460272           019128
ORG-AG  FOREST SERVICE                                                         AUTHOR  BRUCE H D
TITLE   OPERATION UPSHOT KNOTHOLE, PROJECT 8.11A, INCENDIARY EFFECTS ON BUILDING AND INTERIOR KINDLING FUELS

WT-777                                                                 550500          A U        0056         A995145          019125
ORG-AG  DAVID TAYLOR MODEL BASIN, NAVY                                         AUTHOR  BENJAMIN V E
TITLE   OPERATION UPSHOT KNOTHOLE, PROJECT 8.12B, SUPPLEMENTARY PRESSURE MEASUREMENTS

WT-779                                                                 540100          A U        0142         B951672          019123
ORG-AG  ARMED FORCES SPECIAL WEAPONS PROJECT                                   AUTHOR  GREER W R
TITLE   OPERATION UPSHOT KNOTHOLE TECHNICAL PHOTOGRAPHY, PROJECT 9.1, REPORT TO THE TEST DIRECTOR

WT-781                                                                 540200          A U        0044         B951674          019142
ORG-AG  WATERWAYS EXPERIMENT STATION, ARMY                                     AUTHOR  SHOCKLEY W G
TITLE   EXPERIMENTAL SOIL STABILIZATION, OPERATION UPSHOT-KNOTHOLE, PROJECT 9.7, REPORT TO THE TEST DIRECTOR

WT-793                                                                 530900          A U        0066         A077505          019153
ORG-AG  NAVAL RADIOLOGICAL DEFENSE LAB                                         AUTHOR  BOND V P
TITLE   BIOLOGICAL EFFECTIVENESS OF IONIZING RADIATION WITHIN SHELTERS

WT-794                                                                 530700          A U        0022         611226           019152
ORG-AG  NAVAL RADIOLOGICAL DEFENSE LAB                                         AUTHOR  SILVERMAN M S
TITLE   BACTERIOLOGICAL STUDIES ON ANIMALS EXPOSED TO NEUTRON RADIATION

WT-808                                                                 531200          A U        0030         A078566          019163
ORG-AG  FEDERAL CIVIL DEFENSE ADMINISTRATION                                   AUTHOR
TITLE   EVALUATION OF TRAINING PROGRAM FOR RADIOLOGICAL DEFENSE                PERSONNEL

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      PRI-RPT                        SEC-RPT              ORG-DT     H-CLASS    PG-LF     DOC-AD-NO      DTL-NO

WT-809                                                    541000       A U       0100      A995065        019162
ORG-AG WRIGHT AIR DEVELOPMENT DIV. AF                            AUTHOR  FREEH E J
TITLE  ADDITIONAL DATA ON THE VULNERABILITY OF PARKED AIRCRAFT TO ATOMIC BOMBS

WT-810-EX                                                 791001       A U       0028      A995008        801040
ORG-AG DEPARTMENT OF HEALTH, EDUCATION AND WELFARE               AUTHOR  LAUG E P
TITLE  OPERATION UPSHOT KNOTHOLE, EXPOSURE OF DRUGS TO NUCLEAR EXPLOSIONS, PROJECT 22.4, EXTRACTED VERSION

WT-811                                                    540200       A U       0098      417093         019160
ORG-AG CALIFORNIA. UNIV, SCHOOL OF MEDICINE                      AUTHOR  RAINEY C T
TITLE  DISTRIBUTION AND CHARACTERISTICS OF FALLOUT AT DISTANCES GREATER THAN 10 MILES FROM GROUND ZERO, MARCH AND APRIL 1953

WT-812                                                    540200       A U       0054      A078560        019159
ORG-AG CALIFORNIA UNIV, SCHOOL OF MEDICINE                       AUTHOR  LINDBERG R G
TITLE  ENVIRONMENTAL AND BIOLOGICAL FATE OF FALL-OUT FROM NUCLEAR  DETONATIONS IN AREAS ADJACENT TO THE NEVADA PROVING GROUNDS

WT-814                                                    540100       A U       0072      A073472        019157
ORG-AG ROCHESTER.  UNIV                                          AUTHOR  DAHL A H
TITLE  OPERATION UPSHOT KNOTHOLE. EFFECTIVE ENERGY OF RESIDUAL GAMMA RADIATION

WT-817                                                    530600       A U       0172      A073471        019171
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY, FIELD COMMAND              AUTHOR  COLLISON T D
TITLE  RADIOLOGICAL SAFETY OPERATION

WT-820                                                    540100       A U       0066      A080270        019168
ORG-AG ATOMIC ENERGY COMMISSION                                  AUTHOR  PLOUGH H H
TITLE  GENETIC EFFECTS OF FAST NEUTRONS FROM NUCLEAR DETONATIONS
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H-N                                                       000000        A U       0412     A995081           019311
ORG-AG HOLMES AND NARVER INC                                   AUTHOR
TITLE  COMPLETICN REPORT, OPERATICN CASTLE

IOC-1-EX                                                  810101        A U       0047     A995095           810794
ORG-AG ARMED FORCES SPECIAL WEAPCNSS PROJECT                   AUTHOR
TITLE  OPERATION CASTLE, PRCJECT SUMMARIES (REVISFD), EXTRACTED VERSION

JTF-7                                                     810101        A U       0091     A995092           810737
ORG-AG JOINT TASK FORCE 7                                      AUTHOR  CLARKSON P W
TITLE  JOINT TASK FORCE 7 CPERATICN CRDER NO. 1-53, EXTRACTED VERSION

JTF-7                                                     540000        A U       0051     A995141           811628
ORG-AG JOINT TASK FORCE 7                                      AUTHOR
TITLE  CPERATICN CASTLE, PACIFIC PROVING GROUNDS, REPORT OF COMMANDER, TASK GROUP 7.5, SPRING OF 1954

JTF-7-OP-1-53                                             540511        A U       0185     A951615           019324
ORG-AG JOINT TASK FORCE 7                                      AUTHOR
TITLE  JOINT TASK FORCE 7, CCPMANDER TASK GROUP 7.3 OPERATION PLAN 1-53

JTF-7-OP-3-53                                             811101        A U       0150     A995136           820441
ORG-AG JOINT TASK FORCE 7                                      AUTHOR  CLARKSON P W
TITLE  CPERATION CASTLE, OPERATICN PLAN NO. 3-53, MARCH-MAY 1954, EXTRACTED VERSION

JTF-7-S-198-54W                                           000000        A U       0197     A995128           801482
ORG-AG JOINT TASK FORCE 7                                      AUTHOR
TITLE  CPERATION CASTLE, CCPPANDER TASK GROUP 7.2, JOINT TASK FORCE 7, FINAL REPORT

KT-81-OC26(R)                                   CNA-6035F 820401        A U       0530     A117574           820606
ORG-AG KAMAN TEMPO                                             AUTHOR  MARTIN E J
TITLE  CASTLE SERIES, 1954

NRDL-TR-147                                               560113        A U       0022     138164            012535
ORG-AG NAVAL RADIOLOCICAL DEFENSE LAB                          AUTHOR  SHIPMAN W H
TITLE  4-PI GAMMA ICAICATICN CHAMBER DECAY MEASUREMENTS OF FALL-   OUT SAMPLES FROM OPERATION CASTLE

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NRL-4519-EX                    RD-513-EX                      811101         A U        0041      A995138           820461
ORG-AG NAVAL RES LAB                                               AUTHOR  BECK C A
TITLE  OPERATION CASTLE, PROJECT 18.3, HIGH RESOLUTION SSPECTROSCOPY, EXTRACTED VERSION

NRL-4590                                                      550600         A U        0024      A951609           012958
ORG-AG NAVAL RES LAB                                               AUTHOR  FUSSELL W B
TITLE  CHORD EXPERIMENT

NRL-4616                                                      560820         A U        0018      A995118           012963
ORG-AG NAVAL RES LAB                                               AUTHOR  FUSSELL W B
TITLE  COLOR TEMPERATURES AT OPERATION CASTLE

SFE                                                           811101         A U        0108      A995144           820571
ORG-AG SANTA FE OPERATIONS OFFICE, AEC                             AUTHOR
TITLE  OPERATION CASTLE, REPORT OF THE MANAGER, SANTA FE OPERATIONS, EXTRACTED VERSION

TEMPO-TA0184-8-I                                              000000         A U        0046      A995080           800776
ORG-AG GENERAL ELECTRIC CO. TEMPO                                  AUTHOR
TITLE  AIRCRAFT DECONTAMINATION

WT-9002-EX                                                    811101         A U        0056      A995143           820572
ORG-AG SANDIA CORP                                                 AUTHOR  PERRET W R
TITLE  GENERAL REPORT OF WEAPONS TESTS, GROUND MOTION STUDIES ON OPERATIONS IVY AND CASTLE, EXTRACTED VERSION

WT-901                                                        550700         A U        0064      356271            019219
ORG-AG CAMBRIDGE RES LABS. AF                                      AUTHOR  CHRISTENSEN W J
TITLE  BLAST EFFECTS ON MISCELLANEOUS STRUCTURES

WT-902-EX                                                     810401         A U        0098      A995102           810820
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                        AUTHOR  HANLON P
TITLE  OPERATION CASTLE, PROJECTS 1.1A, 1.1B, AND 1.1D, BLAST PRESSURES AND SHOCK PHENOMENA MEASUREMENTS BY PHOTOGRAPHY, EXTRAC
       TED VERSION
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     PRI-RPT                        SEC-RPT              ORG-DT    H-CLASS    PG-LF    DDC-AD-NO    DTL-NO

WT-903
ORG-AG NAVAL ORDNANCE LAB                                550900      A U      0019     361766       019216
TITLE  BASE SURGE MEASUREMENTS BY PHOTOGRAPHY                AUTHOR  WILLEY R L

WT-904-EX
ORG-AG SANDIA CORP                                       810515      A U      0043     A995108      810984
TITLE  OPERATION CASTLE, GROUND LEVEL PRESSURES FROM SURFACE BURSTS, PROJECT 1.2A, EXTRACTED VERSION
                                                             AUTHOR  BROYLES C D

WT-905
ORG-AG BALLISTIC RES LABS. ARMY                          570500      A U      0047     341053       019222
TITLE  GROUND SURFACE AIR PRESSURE VERSUS DISTANCE FROM HIGH YIELD DETONATIONS
                                                             AUTHOR  MESZAROS J J

WT-906
ORG-AG SANDIA LABS                                       580127      A U      0015     361771       019223
TITLE  DYNAMIC PRESSURE MEASUREMENTS                         AUTHOR  BROYLES C D

WT-907
ORG-AG SANDIA CORP                                       540100      A U      0042     361922       019221
TITLE  INSTRUMENTATION FOR PROJECTS 1.2A, 1.3 AND 1.7, OPERATION CASTLE
                                                             AUTHOR  THOMPSON R H

WT-908-EX
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT              810401      A U      0266     A995105      810823
TITLE  OPERATION CASTLE, PROJECT 1.4, UNDERWATER PRESSURE MEASUREMENTS, EXTRACTED VERSION
                                                             AUTHOR  THALER WJ

WT-909
ORG-AG BUREAU OF SHIPS. NAVY                             570903      A U      0016     337912       019242
TITLE  ACOUSTIC PRESSURE SIGNALS IN WATER (SOFAR)            AUTHOR

WT-910
ORG-AG SCRIPPS INST OF OCEANOGRAPHY                      591019      A U      0046     341056       019240
TITLE  WATER WAVE MEASUREMENTS                               AUTHOR  ISAACS J D

WT-911
ORG-AG BALLISTIC RES LABS. ARMY                          570300      A U      0050     361767       019238
TITLE  DYNAMIC PRESSURE INVESTIGATION                        AUTHOR  BRYANT E J
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      PRI-RPT                        SEC-RPT                ORG-DT     H-CLASS    PG-LF     DTC-AD-NO      DTL-NO

WT-912                                                      590316       A U      0044      341055         019236
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                         AUTHOR  DEMPSEY R H
TITLE  GAMMA RADIATION EXPOSURE.

WT-913                                                      590224       A U      0034      338330         019234
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                         AUTHOR  BROWN P
TITLE  GAMMA RATE VERSUS TIME

WT-914-EX                                                   810401       A U      0079      A995099        810776
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                        AUTHOR  HANSCOME T D
TITLE  OPERATION CASTLE, PROJECT 2.3, NEUTRON FLUX MEASUREMENTS, EXTRACTED VERSION

WT-915                                                      560100       A U      0172      361836         019230
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                              AUTHOR  STETON R L
TITLE  DISTRIBUTION AND INTENSITY OF FALLOUT

WT-916-EX                                                   810515       A U      0134      A995116        811038
ORG-AG CHEMICAL WARFARE LAB. ARMY                                  AUTHOR  WILSEY E F
TITLE  OPERATION CASTLE, FALLOUT STUDIES, PROJECT 2.5B, EXTRACTED VERSION

WT-917-EX                                                   810515       A U      0152      A995109        810983
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                              AUTHOR  TOMPKINS E R
TITLE  OPERATION CASTLE, CHEMICAL, PHYSICAL, AND RADIOCHEMICAL CHARACTERISTICS OF THE CONTAMINANT, PROJECT 2.6A, EXTRACTED VERS
       ION

WT-918                                                      560200       A U      0060      224417         019254
ORG-AG CHEMICAL AND RADIOLOGICAL LABS. ARMY                        AUTHOR  TOMPKINS R C
TITLE  RADIOCHEMICAL ANALYSIS OF FALLOUT

WT-919                                                      550500       A U      0116      362095         019252
ORG-AG STANFORD RES INST                                           AUTHOR  SWIFT L M
TITLE  AIR PRESSURE MEASUREMENTS
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           PRI-RPT                            SEC-RPT               ORG-DT      H-CLASS      PG-LF       DDC-AD-NO         DTL-NO

WT-920-EX                                                           820604        A U        0036       A995166           820787
ORG-AG STANFORD RES INST                                                   AUTHOR  VAILE R B
TITLE  OPERATION CASTLE, PROJECT 3.2, CRATER SURVEY, EXTRACTED VERSION

WT-921                                                              550300        A U        0048       465294            019248
ORG-AG FORE I SERVICE                                                      AUTHOR  STOREY T G
TITLE  BLAST EFFECTS ON TREE STAND

WT-922                                                              550300        A U        0048       361834            019246
ORG-AG BUREAU OF ORDNANCE. NAVY EVALUATION AND ANALYSIS                    AUTHOR  DAVIDSON G M
TITLE  SEA MINEFIELD NEUTRALIZATION BY MEANS OF A SURFACE DETONATED NUCLEAR EXPLOSION

WT-923                                                              541000        A U        0104       465295            019244
ORG-AG NAVAL MEDICAL RES INST                                              AUTHOR  CRONKITE E P
TITLE  STUDY OF RESPONSE OF HUMAN BEINGS ACCIDENTALLY EXPOSED TO SIGNIFICANT FALLOUT RADIATION, OPERATION CASTLE, FINAL REPORT
       PROJECT 4.1

WT-924                                                              560100        A U        0044       361832            019263
ORG-AG STRATEGIC AIR COMMAND. AF                                           AUTHOR  TRIANTAFELLU R
TITLE  TEST OF INTERIM IBDA PROCEDURES, REPORT TO THE TEST DIRECTOR, OPERATION CASTLE

WT-925                                                              560600        A U        0166       338333            019261
ORG-AG AIRCRAFT LAB. AF                                                    AUTHOR  MILLER G C
TITLE  BLAST AND THERMAL EFFECTS ON B-36 AIRCRAFT IN FLIGHT, OPERATION CASTLE

WT-926                                                              570400        A U        0072       338026            019259
ORG-AG COOK RES LABS                                                       AUTHOR  LUCHSINGER
TITLE  THERMAL EFFECTS ON B-47E AIRCRAFT IN FLIGHT, OPERATION CASTLE

WT-927                                                              571025        A U        0464       362110            019258
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                      AUTHOR  MOLUMPHY G G
TITLE  OPERATION CASTLE, PROOF TESTING OF ATOMIC WEAPONS SHIP COUNTERMEASURES
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WT-928                                                     000000        A U        0064     465306           019278
ORG-AG CHEMICAL AND RADICLOGICAL LABS. ARMY                     AUTHOR  MALONEY J C
TITLE  DECONTAMINATICN AAC PROTECTICN, REPORT TO THE SCIENTIFIC DIRECTOR, OPERATION CASTLE


WT-929                                                     570400        A U        0075     361772           019276
ORG-AG EVANS SIGNAL LAB. ARPY                                   AUTHOR  DANIELS F B
TITLE  EFFECTS OF NUCLEAR DETCNATICNS ON THE IONCSPHERE, OPERATION CASTEL


WT-931-EX                                                  810401        A U        0059     A995117          810982
ORG-AG OFFICE FOR ATCMIC ENERGY. AF                             AUTHOR  OLMSTED G B
TITLE  OPERATICN CASTLE, DETECTICN OF AIRBORNE LCW FREQUENCY SOUND FROM NUCLEAR EXPLOSIONS, PROJECT 7.2, EXTRACTEC VERSION


WT-932-EX                                                  810401        A U        0033     A995084          810724
ORG-AG CEFENSE ATOMIC SUPPORT AGENCY, FIELD COMMAND             AUTHOR  REED C K
TITLE  OPERATION CASTLE, NUCLEAR CALIBRATION ANALYSIS OF ATOMIC CEVICE DEBRIS, PROJECT 7.4, EXTRACTED VERSION


WT-933                                                     580127        A U        0044     357960           019268
ORG-AG EG AND G INC                                             AUTHOR
TITLE  CLOUD PHOTCGRAPHY


W7-934-EX                                                  810515        A U        0118     A995123          811479
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                     AUTHOR  COLEMAN K D
TITLE  OPERATION CASTLE, SUMMARY REPORT OF THE CCMMANDER, TASK UNIT 13, MILITARY EFFECTS, PROGRAMS 1-9, EXTRACTED VERSICN


WT-935-FX                                                  810401        A U        0089     A995085          810736
ORG-AG SCRIPPS INST CF CCEANCGRAPHY                             AUTHOR  FOLSOM T R
TITLE  OPERATICN CASTLE, DISTRIEUTION OF RADIOACTIVE FALLOUT BY SURVEY AND ANALYSES OF SEA WATER, PROJECT 2.7, EXTRACTED VERSIO
       N


WT-936                                                     000000        A U        0054     617134           019289
ORG-AG NAVAL RADICLOGICAL DEFENSE LAB                           AUTHOR  COHN S H
TITLE  NATURE AND EXTENT CF INTERNAL RADIOACTIVE CONTAMINATION OF HUMAN BEINGS, PLANTS, AND ANIMALS EXPOSED TO FALLOUT
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WT-937                                                       550400       A U      0046      465292          019288
ORG-AG  NAVAL MEDICAL RES INST                                  AUTHOR  BOND V P
TITLE   MEDICAL EXAMINATION OF RONGELAP PEOPLE SIX MONTHS AFTER EXPOSURE TO FALLOUT, OPERATION CASTLE, ADDENDUM REPORT, PROJECT
        4.1A, REPORT TO THE SCIENTIFIC DIRECTOR

WT-938-EX                                                    800201       A U      0043      A995077         810113
ORG-AG  NAVAL MEDICAL RES INST                                  AUTHOR  SHARP R
TITLE   OPERATION CASTLE, EXPOSURE OF MARSHALL ISLANDERS AND AMERICAN MILITARY PERSONNEL TO FALLOUT, PROJECT 4.1 ADDENDUM, EXTRA
        CTED VERSION

WT-939                                                       551200       A U      0046      338337          019286
ORG-AG  NAVAL RADIOLOGICAL DEFENSE LAB                          AUTHOR  SONDHAUS C A
TITLE   PHYSICAL FACTORS AND DOSIMETRY IN THE MARSHALL ISLAND RADIATION EXPOSURES

WT-940-EX                                                    800201       A U      0073      A995017         801152
ORG-AG  LOS ALAMOS SCIENTIFIC LAB                               AUTHOR
TITLE   OPERATION CASTLE, REPORT OF COMMANDER TASK GROUP 7.1, EXTRACTED VERSION

WT-942-EX                                                    810401       A U      0068      A995086         810735
ORG-AG  LOS ALAMOS SCIENTIFIC LAB                               AUTHOR  SERVIS J D
TITLE   OPERATION CASTLE, RADIOLOGICAL SAFETY, EXTRACTED VERSION

WT-954                                                       580418       A U      0020      465307          019293
ORG-AG  SCRIPPS INST OF OCEANOGRAPHY                            AUTHOR  FOLSOM T R
TITLE   RADIOACTIVITY OF OPEN SEA PLANKTON SAMPLES




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AEC                                                                 000000        A U        0055        A995119        019590
ORG-AG ATOMIC ENERGY COMMISSION                                           AUTHOR  CORSBIE R L
TITLE  PROJECT SUMMARIES OF CIVIL EFFECTS TESTS, OPERATION TEAPOT

AFCRC-TR-57-123                                                     571200        A U        0053        A995121        001226
ORG-AG CAMBRIDGE RES CENTER. AF                                           AUTHOR  HOUGHTEN R A
TITLE  ELECTROMAGNETIC MEASUREMENTS, OPERATION TEAPOT

AFSWC-OP-1-54-EX                                                    811101        A U        0245        A995137        820440
ORG-AG SPECIAL WEAPONS CENTER. AF                                         AUTHOR  CANTERBURY W M
TITLE  OPERATION TEAPOT, OPERATIONAL PLAN 1-54 FIELD TEST GROUP 5 (PROV), EXTRACTED VERSION

AG-C-8882                                                           551001        A U        0052        A995046        007456
ORG-AG CARNEGIE INST OF WASH DC, DEPT OF TERRESTRIAL MAGN                 AUTHOR
TITLE  CBR DEFENSE TEAM TRAINING(U)

AG-4496                                                             550523        A U        0024        A078551        007452
ORG-AG DEPARTMENT OF THE ARMY                                             AUTHOR
TITLE  DAMAGE COMPARISON CHART, ANNEX Q TO FINAL REPORT EXERCISE DESERT ROCK 6

AG-4496                                                             550523        A U        0104        A995140        007451
ORG-AG ARMY                                                               AUTHOR
TITLE  EXERCISE DESERT ROCK 6, FINAL REPORT OF OPERATIONS

AGMS                                                                550600        A U        0065        A995047        007453
ORG-AG ARTILLERY SCHOOL GUIDED MISSILE DEPT. ARMY                         AUTHOR
TITLE  LOCATION OF ATOMIC BURSTS BY A FIELD ARTILLERY OBSERVATION FBATTERY, EXERCISE DESERT ROCK 6

AICBB-G-354-2                                                       550801        A U        0050        A080235        771476
ORG-AG ARMORED SCHOOL. ARMY                                               AUTHOR
TITLE  DESERT ROCK 6, ARMORED TASK FORCE, REPORT OF TEST, PARTS 1 THROUGH 3

ARMY                                                                000000        A U        0119        A080237        771479
ORG-AG ARMORED SCOOL. ARMY                                                AUTHOR
TITLE  DESERT ROCK 6, ARMORED TASK FORCE, DETAILED PLAN OF TEST PART 1

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DESERT-ROCK-CO-1                                                 550200         A U       0046      A080229        771470
ORG-AG CAMP DESERT RCCK. ARPY                                        AUTHOR
TITLE  CESERT ROCK 6, OPERATION CRDER NO. 1

DESERT-ROCK-OO-2                                                 550200         A U       0036      A078820        771469
ORG-AG CAMP DESERT RCCK. ARMY                                        AUTHOR
TITLE  DESERT RCCK 6, OPERATICN ORCER NO. 2

DESERT-ROCK-OO-3                                                 550200         A U       0010      A080230        771468
ORG-AG CAMP DESERT RCCK. ARPY                                        AUTHOR
TITLE  DESERT ROCK 6, GPERATICN CRDER NC. 3

DESERT-ROCK-OO-4                                                 550200         A U       0039      B951724        771467
ORG-AG CAMP DESERT ROCK. ARPY                                        AUTHOR
TITLE  DESERT ROCK 6, OPERATICN ORDER NO. 4

DESERT-ROCK-OO-5                                                 550300         A U       0040      A080228        771471
ORG-AG CAMP DESERT RCCK. ARPY                                        AUTHOR
TITLE  DESERT ROCK 6, OPERATICN CRDER NO. 5

DESFRT-ROCK-OO-6                                                 550300         A U       0018      A080231        771472
ORG-AG CAMP DESERT ROCK. ARMY                                        AUTHOR
TITLE  DESERT RCCK 6, CPERATICN CRDER NO. 6

DESFRT-ROCK-OO-7                                                 550300          A U      0010      A080232        771474
ORG-AG CAMP DESERT ROCK. ARMY                                        AUTHOR
TITLE  DESERT ROCK 6, OPEFATICN ORDER NO. 7

DESERT-ROCK-OO-8                                                 550400         A U       0011      A080233        771473
ORG-AG CAMP DESERT RCCK. ARPY                                        AUTHOR
TITLE  DESERT ROCK 6, OPERATICN ORDER NO. 8

DESFRT-ROCK-OO-9                                                 550420         A U       0055      A080234        771475
ORG-AG CAMP DESERT RCCK. ARMY                                        AUTHOR
TITLE  DESERT RCCK 6, OPEPATICN CRDER NO. 9

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      PRI-RPT                        SEC-RPT                  ORG-DT      H-CLASS      PG-LF      DDC-AD-NO      DTL-NO

DESERT-ROCK-6                                                 550511        A U        0012       A078568        007454
ORG-AG MARINE CORPS                                                   AUTHOR
TITLE  REPORT OF EXERCISE DESERT ROCK 6, MARINE CORPS


DESERT-ROCK-6                                                 550200        A U        0090       A078569        007455
ORG-AG MARINE CORPS                                                   AUTHOR
TITLE  DESERT ROCK 6, MARINE CORPS, OPERATION ORDER 1-55


ERDL-TR-1468-TR-EX                                            810101        A U        0101       A995098        810800
ORG-AG ENGINEER RES AND DEVELOPMENT LABS. ARMY                        AUTHOR  DAVIS N J
TITLE  FIELD FORTIFICATIONS TEST, EXERCISE DESERT ROCK 5, PROJECTS 8-12-75-001, EXTRACTED VERSION


ERDL-1443                                                     560425        A U        0028       A995043        007868
ORG-AG ENGINEER RES AND DEV LABS. ARMY                                AUTHOR  NELSON R C
TITLE  EFFECTS OF ATOMIC WEAPONS ON ENGINEER HEAVY EQUIPMENT


ITR-1171                                                      550500        A U        0076       A995064        019504
ORG-AG CALIFORNIA. UNIV., AT LOS ANGELES                              AUTHOR  TAPLIN G V
TITLE  MEASUREMENT OF INITIAL AND RESIDUAL RADIATIONS BY CHEMICAL METHODS, OPERATION TEAPOT


ITR-1185                                                      550000        A U        0047       A078821        019532
ORG-AG NEW YORK OPERATIONS OFFICE, HEALTH AND SAFETY LAB.             AUTHOR  LEVINE H D
TITLE  MEASUREMENTS OF BETA AND GAMMA RAY CHARACTERISTICS OF SHOT DEBRIS AND FALLOUT OF NUCLEAR WEAPONS


JRB-2-816-03-423-00          DNA-6012F                        811125        A U        0104       A113538        820246
ORG-AG JRB ASSOCIATES                                                 AUTHOR  PONTON J
TITLE  SHOT APPLE 2, A TEST OF THE TEAPOT SERIES, 5 MAY 1955


JRB-2-816-03-423-00          DNA-6011F                        811124        A U        0086       A113539        820244
ORG-AG JRB ASSOCIATES                                                 AUTHOR  MAAG C
TITLE  SHOT BEE, A TEST OF THE TEAPOT SERIES, 22 MARCH 1955


JRB-2-816-03-423-00          DNA-6013F                        811127        A U        0260       A114082        820353
ORG-AG JRB ASSOCIATES                                                 AUTHOR  PONTON J
TITLE  SHOTS ESS THROUGH MET AND SHOT ZUCCHINI, THE FINAL TEAPOT TESTS, 23 MARCH - 15 MAY 1955
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JRB-2-816-03-423-00         DNA-6009F                           811123        A U       0274      A113537          820245
ORG-AG JRB ASSOCIATES                                                 AUTHOR  PONTON J
TITLE  OPERATICN TEAPOT, 1955 CCNTINENTAL NUCLEAR WEAPONS TEST SERIES

JRB-2-816-03-423-C0         DNA-6010F                           811126        A U       0188      A114080          820329
ORG-AG JRB ASSOCIATES                                                 AUTHOR  MAAG C
TITLE  SHOTS WASP THRCUGH HCRNETS, THE FIRST FIVE TEAPOT TESTS, 18 FEBRUARY - 12 MARCH 1955

SAI-81-216-WA               DNA-5354F                           800715        A U       0098      A121701          821002
ORG-AG SCIENCE APPLICATICNS INC                                       AUTHOR  GOETZ J
TITLE  ANALYSIS OF RADIATION EXPOSURE FOR TROOP CBSERVERS, EXERCISE DESERT ROCK 6, OPERATICN TEAPOT, FINAL REPORT FOR 1 MARCH 1
       980 - 15 JULY 1980

WRAIR-15-55                 AFSWP-893                           551100        A U       0059      A995149          006037
ORG-AG WALTER REED ARMY MEDICAL CENTER                                AUTHOR  HARTGERING J B
TITLE  RECOVERY OF RADICACTIVE IODINE AND STRONTIIUM FROM HUMAN URINE, OPERATION TEAPOT

WT-1101                                                         550500        A U       0052      460280           019394
ORG-AG CAMBRIDGE RES CTR, OPERATIONAL APPLICATIONS LAB. A             AUTHOR  HASKELL N A
TITLE  MEASUREMENT OF FREE AIR ATOMIC BLAST PRESSURES

WT-1102                                                         580515          U       0116      611253           019395
ORG-AG NAVAL ORDNANCE LAB                                             AUTHOR  MOULTON J F
TITLE  SHOCK WAVE PHCTOCRAPHY

WT-1103                                                         550500          U       0036      611254           019397
ORG-AG SANDIA LABS                                                    AUTHOR  REED J W
TITLE  GROUND LEVEL PICRCBARCGRAPHIC PRESSURE MEASUREMENTS FROM A HIGH ALTITUDE SHCT

WT-1104                                                         550500          U       0076      224419           019398
ORG-AG NAVAL ELECTRCNICS LAB                                          AUTHOR  MCLOUGHLIN R C
TITLE  PRESHOCK SOUND VELOCITIES NEAR THE GROUND IN THE VICINITY  OF AN ATOMIC EXPLOSION


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WT-1105
ORG-AG ENGINEER RES AND DEVELOPMENT LABS. ARMY                 950500        A U        0080       491309          019399
TITLE  CRATER MEASUREMENTS, OPERATION TEAPOT, PROJECT 1.6, REPORT TO THE TEST DIRECTOR
                                                                    AUTHOR  LEWIS J G

WT-1106
ORG-AG STANFORD RES INST                                       580303        A U        0120       617181          019401
TITLE  UNDERGROUND EXPLOSION EFFECTS                                AUTHOR  SACHS D C

WT-1107
ORG-AG BALLISTIC RESEARCH LABS                                 580523        A U        0034       465423          019402
TITLE  STRUCTURES INSTRUMENTATION, OPERATION TEAPOT PROJECT 3.10   AUTHOR  LORRIAN P

WT-1108
ORG-AG SANDIA LABS                                             560600          U        0026       611321          019404
TITLE  MATERIAL VELOCITY MEASUREMENTS OF HIGH ALTITUDE SHOT         AUTHOR  REED J  W

WT-1109
ORG-AG STANFORD RES INST                                       570909          U        0194       617182          019405
TITLE  AIRBLAST OVERPRESSURE AND DYNAMIC PRESSURE OVER VARIOUS SURFACES
                                                                    AUTHOR  SACHS D C

WT-1110
ORG-AG SANDIA LABS                                             580228        A U        0070       617155          019406
TITLE  SPECIAL MEASUREMENTS OF DYNAMIC PRESSURE VERSUS TIME AND DISTANCE
                                                                    AUTHOR  BANISTER J R

WT-1111
ORG-AG NAVAL ORDNANCE LABORATORY                               580613        A U        0170       610481          019407
TITLE  DRAG-FORCE MEASUREMENTS, OPERATION TEAPOT PROJECT 1.12 FEBRUARY - MAY 1955
                                                                    AUTHOR  KORNHAUSER M

WT-1112
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                     570816        A U        0016       617177          019409
TITLE  OPERATION TEAPOT, EVALUATION OF A RADIOLOGICAL DEFENSE WARNING SYSTEM (PROJECT CLOUDBURST)
                                                                    AUTHOR  PETRIKEN T E

WT-1113
ORG-AG CHEMICAL WARFARE LABS. ARMY                             570621        A U        0052       0951675         019410
TITLE  DUST DENSITY VERSUS TIME AND DISTANCE IN THE SHOCK WAVE      AUTHOR  GORDON P G

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       PRI-RPT                          SEC-RPT                 ORG-DT     H-CLASS     PG-LF     DDC-AD-NO     DTL-NO

WT-1114                                                         591023       A U       0096      617152        019412
ORG-AG BALLISTIC RES LABS. ARMY                                      AUTHOR  BURDEN M S
TITLE  TRANSIENT DRAG CHARACTERISTICS OF A SPHERICAL MODEL

WT-1115-EX                                                      010101       A U       0046      A995087       810733
CRG-AG SIGNAL RES AND DEV LAB. ARMY                                  AUTHOR  GRAHAM J B
TITLE  CPERATION TEAPOT, GAPPA EXPCSURE VERSUS DISTANCE, PROJECT 2.1, EXTRACTED VERSION

WT-1116-EX                                                      010101       A U       0044      A995088       810732
ORG-AG NAVAL RES LAB                                                 AUTHOR  HANSCOME T D
TITLE  OPERATION TEAFOT, NEUTRCA FLUX MEASUREMENTS, PROJECT 2.2, EXTRACTED VERSION

WT-1117                                                         550500       A U       0056      617180        019416
ORG-AG NAVAL RADIOLCGICAL DEFENSE LAB                                AUTHOR  JOHNSON R F
TITLE  NEUTRON INCUCED RADIOACTIVE ISOTCPES IN SCILS

WT-1118-FX                                                      010101       A U       0059      A995096       810795
ORG-AG CEFENSE ATOMIC SUPPCRT AGENCY                                 AUTHOR  GRAHAM J B
TITLE  OPERATION TEAPOT, PROJECT 2.4, GAMMA DOSE RATE VERSUS TIME AND DISTANCE, EXTRACTED VERSION

WT-1119                                                         580723         U       0138      449680        019420
ORG-AG CHEMCIAL CORPS ENGINEERING CCMMAND. ARMY                      AUTHOR
TITLE  FALLCUT STUDIES

WT-1120                                                         550000       A U       0060      224421        019422
ORG-AG NAVAL MEDICAL RES INST                                        AUTHOR  IMIRIE G W
TITLE  RADIATION ENERGY ABSCRBEC BY HUMAN PHANTOPS IN A FISSION FALLOUT FIELD

WT-1121-EX                                                      010101       A U       0122      A995103       810822
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                          AUTHOR  HENDRICKSON J R
TITLE  OPERTION TEAPCT, PRCJECT 2.7, SHIELDING STUDIES, EXTRACTEC VERSION

WT-1122                                                         571011         U       0036      617153        019426
ORG-AG SPECIAL WEAPCNS CENTER. AF                                    AUTHOR  CRUMLEY P M
TITLE  CONTACT RADIATION HAZARD ASSOCIATED WITH CONTAMINATED AIRCRAFT
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        PRI-RPT                          SEC-RPT                   ORG-DT      H-CLASS     PG-LF       DDC-AD-NO        DTL-NO
WT-1123
ORG-AG BALLISTIC RES LABS. ARMY                                    591028         U        0132        339948           019427
                                                                       AUTHOR  BRYANT E J
TITLE  RESPONSE OF DRAG TYPE EQUIPMENT TARGETS IN THE PRECURSOR ZONE

WT-1124
ORG-AG ARMOUR RES FOUNDATION                                       550500         U        0174        617149           019429
                                                                       AUTHOR  SCHMIDT L A
TITLE  STUDY OF DRAG LOADING OF STRUCTURES IN THE PRECURSOR ZONE

WT-1125
ORG-AG BUREAU OF YARDS AND DOCKS. NAVY                             580728        A U       0124        617172           019431
                                                                       AUTHOR  DOHRENWEND C D
TITLE  FLEXIBLE MEASURING DEVICES  AND INSPECTION OF OPERATION JANGLE STRUCTURES

WT-1126
ORG-AG ILLINOIS UNIVERSITY                                         571011        A U       0054        617150           019432
                                                                       AUTHOR  SINNAMOA N
TITLE  BEHAVIOR OF UNDERGROUND STRUCTURES SUBJECTED TO AN UNDERGROUND EXPLOSION, OPERATION TEAPOT PROJECT 3.3.2 FEBRUARY - MAY
       1955

WT-1127
ORG-AG ILLINOIS. UNIV                                              570820        A U       0084        617175           019434
                                                                       AUTHOR  WOODRING R E
TITLE  AIR BLAST EFFECTS ON UNDERGROUND STRUCTURES, OPERATION TEAPOT, PROJECT 3.4

WT-1128
ORG-AG BUREAU OF YARDS AND DOCKS. NAVY                             561200        A U       0068        617173           019436
                                                                       AUTHOR  VAILE R B
TITLE  EVALUATION OF EARTH COVER AS PROTECTION TO ABOVEGROUND STRUCTURES

WT-1129
ORG-AG SPECIAL WEAPONS CENTER. AF                                  581201         U        0122        617174           019438
                                                                       AUTHOR  SIMMON G K
TITLE  EFFECT OF POSITIVE PHASE LENGTH OF BLAST ON DRAG AND SEMIDRAG INDUSTRIAL BUILDINGS, PART I

WT-1130
ORG-AG BUREAU OF YARDS AND DOCKS. NAVY                             570200        A U       0084        224422           019440
                                                                       AUTHOR  ALLGOOD J R
TITLE  TEST OF CONCRETE PANELS, REPORT TO THE TEST DIRECTOR, OPERATION TEAPOT, PROJECT 3.8
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       PRI-RPT                        SEC-RPT              ORG-DT      H-CLASS     PG-LF      DDC-AD-NO        DTL-NO

WT-1131                                                    570506        A U       0026       340138           019442
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                     AUTHOR  OBRIEN E J
TITLE  OPERATION TEAPOT, RESPONSE OF SMALL PETROLEUM PRODUCTS STORAGE TANKS, REPORT TO THE TEST DIRECTOR

WT-1132                                                    580131         U        0095       357980           019444
ORG-AG WRIGHT AIR DEVELOPMENT DIV. AF                           AUTHOR  PURKEY G F
TITLE  DESTRUCTIVE LOADS ON AIRCRAFT IN FLIGHT

WT-1133                                                    580718         U        0097       362111           019445
ORG-AG WRIGHT AIR DEVELOPMENT DIV. AF                           AUTHOR  PURKEY G F
TITLE  STRUCTURAL RESPONSE OF F-84F AIRCRAFT IN FLIGHT

WT-1134                                                    580430         U        0129       340137           019447
ORG-AG WRIGHT AIR DEVELOPMENT DIV. AF                           AUTHOR  KESTER J E
TITLE  EVALUATION OF FIREBALL LETHALITY USING BASIC MISSILE STRUCTURES

WT-1135                                                    580228        A U       0094       362112           019449
ORG-AG UNIVERSITY OF DAYTON                                     AUTHOR  WHITFORD D
TITLE  EFFECTS OF NUCLEAR EXPLOSIONS ON FIGHTER AIRCRAFT COMPONENTSOPERATION TEAPOT PROJECT 5.5A

WT-1136                                                    580512        A U       0068       341059           019451
ORG-AG UNIVERSITY OF DAYTON                                     AUTHOR  HOVEY W
TITLE  THERMOELASTIC RESPONSE OF AN ALUMINUM BOX BEAM, OPERATION TEAPOT PROJECT 5.5B

WT-1137                                                    580228         U        0060       460281           019453
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                      AUTHOR  COHEN A E
TITLE  EVALUATION OF MILITARY RADIAC EQUIPMENT

WT-1138                                                    571115         U        0056       420801           019455
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                           AUTHOR  WORK G A
TITLE  ACCURACY OF MILITARY RADIACS

WT-1139                                                    570816        A U       0025       617176           019456
ORG-AG SIGNAL ENGINEERING LABS.  ARMY                           AUTHOR  GRAHAM J
TITLE  RADIATION EFFECTS ON SELECTED COMPONENTS AND MATERIALS, REPORT TO THE TEST DIRECTOR, OPERATION TEAPOT PROJECT 6.2
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WT-1140                                                             570819          A U        0116       341060           019458
ORG-AG SIGNAL ENGINEERIAG LABORATORIES                                 AUTHOR  MILLER M
TITLE  MISSILE DETCAATICA LCCATCR, REPORT TO THE TEST DIRECTOR, OPERATION TEAPOT PRCJECT 6.3

WT-1141                                                             570500          A U        0042       341061           019460
ORG-AG WEAPCNS GUIDANCE LABORATORY, AIR FORCE                          AUTHOR  DEEGAN T
TITLE  TEST OF IBCA EQUIPPEAT, REPORT TO THE TEST DIRECTOR, OPERATION TEAPCT PROJECT 6.4

WT-1142                                                             570802          A U        0018       339916           019462
ORG-AG BUREAU OF AERCNALTICS. NAVY                                     AUTHOR  ZIRKIND R
TITLE  TEST OF AIRBCRNE AAVAL RACARS FOR IBDA

WT-1143                                                             570300          A U        0054       339915           019464
ORG-AG NAVAL AIR PATERIAL CEATER                                       AUTHOR  KVILJORD A
TITLE  MEASUREMENT OF DIRECT AND GROUND REFLECTED THERMAL RADIATIONAT ALTITUDE, OPERATION TEAPOT PROJECT 8.1

WT-1144                                                             56C800          A U        0062       224423           019466
ORG-AG CHEMICAL AND RADICLCGICAL LABS. ARMY                            AUTHOR  ENGQUIST E H
TITLE  PROTECTICN AFFORDED BY OPERATIONAL SMOKE SCREENS AGAINST THERMAL RADIATION, FINAL REPORT

WT-1145                                                             580127            U        0036       339907           019468
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                  AUTHOR  DAY R P
TITLE  THERPAL PEASUREMENTS FRCP AIRCRAFT IN FLIGHT

WT-1146                                                             590708          A U        0096       339905           019470
ORG-AG NAVAL RADICLOGICAL DEFENSE LAB                                  AUTHOR  HILLENDAHL R W
TITLE  BASIC THERMAL - RADIATICA PEASUREPENTS

WT-1147                                                             570816          A U        0018       357981           019471
ORG-AG NAVAL RACIOLOGICAL DEFENSE LAB                                  AUTHOR  HOPTON R L
TITLE  RADIANT ENERGY DELIVERED PRIOR TO THE FIRST MINUMUM

WT-1148                                                             580127          A U        0026       617178           019472
ORG-AG NAVAL RADIOLOGICAL DEFENSE LABORATORY                           AUTHOR  PLUM W
TITLE  SPECTROPETER PEASUREPENTS, OPERATION TEAPCT PROJECT 8.4D FEBRUARY - PAY 1955

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       PRI-RPT                          SEC-RPT                ORG-DT      M-CLASS    PG-LF     DDC-AD-NO       DTL-NO

WT-1149                                                        570903        A U      0042      611255          019473
ORG-AG NAVAL RADIOLCGICAL DEFENSE LAB                                 AUTHOR  INN E C Y
TITLE  AIR TEMPERATURE MEASLREMENTS OVER SEVERAL SURFACES, OPERATION TEAPOT, PROJECT 8.4E

WT-1150                                                        550201        A U      0026      341062          019475
ORG-AG NAVAL RADIOLCGICAL DEFENSE LAB                                 AUTHOR  JENKINS R J
TITLE  IRRADIANCE MEASUREMENTS WITH HIGH TIME RESOLUTION

WT-1151                                                        570812        A U      0018      617171          019477
ORG-AG EG AND G                                                       AUTHOR
TITLE  TECHNICAL PHCTOGRAPHY, OPERATION TEAPOT PROJECT 9.1 FEBRUARY - MAY 1955

WT-1152                                                        551000          U      0138      426840          019479
ORG-AG CAMBRIDGE RES CTR, OPERATICNAL APPLICATIONS LAB. A             AUTHOR  GROSSMAN B H
TITLE  ATOMIC CLOUD GROWTH STUDY

WT-1153-EX                                                     810501        A U      0231      A995120         811397
ORG-AG CEFENSE ATCMIC SUPPCRT AGENCY                                  AUTHOR
TITLE  OPFRATION TEAPOT, TECHNICAL SUMMARY OF MILITARY EFFECTS, PROGRAMS 1-9, EXTRACTED VERSION

WT-1154                                                        580314          U      0094      617179          019482
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                 AUTHOR  STETSON R L
TITLE  CISTRIBUTICN AND INTENSITY OF FALLOUT FROM THE UNDERGROUND SHOT

WT-1155                                                        590716          U      0216      617170          019483
ORG-AG BALLISTIC RES LABS. ARMY                                       AUTHOR  BRYANT E J
TITLE  MEASUREMFNTS CF AIR BLAST PHENOMENA WITH SELF RECORDING GAGES

WT-1156-EX                                                     800901        A U      0019      A995055         801794
ORG-AG SPECIAL WEAPCNS CENTER. AF                                     AUTHOR  BANKS J E
TITLE  OPERATION TEAPOT, MANNED PENETRATIONS OF ATOMIC CLCUDS, PROJECT 2.8B, EXTRACTED VERSION

WT-1158-EX                                                     791001        A U      0093      B951749         800965
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT, FC                       AUTHOR  PARSONS H E
TITLE  OPERATION TEAPOT, OPERATICNAL SUMMARY, EXTRACTED VERSION
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        PRI-RPT                          SEC-RPT                ORG-DT     H-CLASS     PG-LF      DDC-AD-NO        DTL-NO

WT-1162                                                          570701      A U        0056      224425           019489
ORG-AG SANDIA LABS                                                     AUTHOR  VORTMAN L J
TITLE  EFFECTS OF A NONIDEAL SHCCK WAVE ON BLAST LOADING OF A STRUCTURE


WT-1163                                                          560300      A U        0038      611328           019491
ORG-AG DEPARTMENT OF HEALTH EDUCATICN AND WELFARE                      AUTHOR  ROWE S C
TITLE  OPERATION TEAPOT, EFFECTS CF NUCLEAR EXPLCSIONS ON BULK FOOD STAPLES


WT-1164                                                          580516      A U        0032      611320           019493
ORG-AG CIVIL EFFECTS GRCUP                                             AUTHOR  REHM F R
TITLE  CIVIL DEFENSE MONITCRING TECHNIQUES


WT-1166                                                          550500        U        0184      465424           019496
ORG-AG DEFENSE ATCMIC SUPPORT AGENCY, FIELD COMMAND                    AUTHOR  COLLISON T D
TITLE  RADIOLOGICAL SAFETY


WT-1168                                                          560300      A U        0113      120061           019499
ORG-AG LOVELACE FOUNDATICN FOR MEDICAL EDUC AND RES                    AUTHOR  BOWEN I G
TITLE  DISTRIBUTICN AND DENSITY CF MISSILES FROM NUCLEAR EXPLOSICN, REPORT TO THE TEST DIRECTOR


WT-1172                                                          580228      A U        0025      A073470          019506
ORG-AG CALIFORNIA. UNIV., SCHCCL OF MEDICINE                           AUTHOR  TAPLIN G V
TITLE  EVALUATION OF THE ACUTE INHALATION HAZARD FROM RADIOACTIVE FALLOUT MATERIALS BY ANALYSIS OF RESULTS FROM FIELD OPERATION
       S AND CONTROLLED INHALATICN STUDIES IN THE LABORATORY


WT-1174-EX                                                       800201      A U        0086      A995007          801031
ORG-AG DIVISICN OF BIOLOGY ANC MEDICINE, AEC                           AUTHOR  DEAL L J
TITLE  CPERATICN TEAPOT, GAMMA AND NEUTRCN RADIATION MEASUREMENTS, PROJECT 39.1, EXTRACTED VERSION


WT-1176                                                          650611      A U        0052      B951676          019514
CRG-AG AMERICAN GAS ASSOCIATICN                                        AUTHOR  CORFIELD G
TITLE  EFFECTS OF A NUCLEAR EXPLCSICN ON TYPICAL NATURAL AND MANUFACTURED GAS UNDERGROUND AND ABOVE-GROUND INSTALLATIONS, INCLU
       DING APPLIANCES IN HOUSES, OPERATION TEAPCT PROJECT 35.48, FEBRUARY - MAY 1955
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WT-1178                                                                  580900         A U        0128         454865             019518
ORG-AG CALIFORNIA. UNIV, SCHOOL OF MEDICINE                                   AUTHOR  BAVRMASH L
TITLE  DISTRIBUTION AND CHARACTERIZATION OF FALLOUT AND AIRBORNE ACTIVITY FROM 10 TO 160 MILES FROM GROUND ZERO, SPRING 1955

WT-1178A                                                                 570500          U         0027         611317             019519
ORG-AG CALIFORNIA. UNIV., AT LOS ANGELES                                      AUTHOR  DICKEY R K
TITLE  BETA SKIN DOSE MEASUREMENTS BY SPECIALLY DESIGNED FILM PACK DOSIMETERS, REPORT TO THE TEST DIRECTOR, OPERATION TEAPOT

WT-1179                                                                  561000          U         0219         611319             019521
ORG-AG LOVELACE FOUNDATION FOR MEDICAL EDUCATION AND RES                      AUTHOR  WHITE C S
TITLE  BIOLOGICAL EFFECTS OF PRESSURE PHENOMENA OCCURRING INSIDE PROTECTIVE SHELTERS FOLLOWING A NUCLEAR DETONATION, REPORT TO
       THE TEST DIRECTOR, OPERATION TEAPOT

WT-1182                                                                  561100         A U        0024         8951677            019527
ORG-AG RADIATION INSTRUMENTS BRANCH, AEC                                      AUTHOR  JOHNSTON R W
TITLE  UTILIZATION OF TELEMETERING TECHNIQUES IN EVALUATING RESIDUAL RADIOACTIVE CONTAMINATION, REPORT TO THE TEST DIRECTOR, OP
       ERATION TEAPOT

WT-1183                                                                  551200          U         0029         A995048            019529
ORG-AG FEDERAL CIVIL DEFENSE ADMINISTRATION                                   AUTHOR  RAINEY C
TITLE  OFF-SITE RADIOLOGICAL DEFENSE TRAINING EXERCISE, OPERATION TEAPOT PROJECT 38.5

WT-1186                                                                  570626          U         0022         A073523            019534
ORG-AG NEW YORK OPERATIONS OFFICE, HEALTH AND SAFETY LAB                      AUTHOR
TITLE  MEASUREMENT OF OFF SITE FALLOUT BY AUTOMATIC MONITORING STATIONS

WT-1190                                                                  580512         A U        0057         A073469            019541
ORG-AG FEDERAL CIVIL DEFENSE ADM                                              AUTHOR  TOLAN J H
TITLE  EVALUATION OF CIVIL DEFENSE RADIOLOGICAL DEFENSE INSTRUMENTS

WT-1194                                                                  610300         A U        0083         611160             019547
ORG-AG OFFICE OF CIVIL DEFENSE                                                AUTHOR  RANDALL F A
TITLE  DAMAGE TO CONVENTIONAL AND SPECIAL TYPES OF RESIDENCES EXPOSED TO NUCLEAR EFFECTS
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       PRI-RPT                        SEC-RPT                ORG-DT     H-CLASS    PG-LF     DOC-AD-NO      DTL-NO

WT-1195                                                      570200       A U      0055      A995070        019549
ORG-AG FEDERAL CIVIL DEFENSE ADMINISTRATION                      AUTHOR  CLARK W G
TITLE  COMPARISON OF RESPONSES OF STRUCTURAL SLABS TO STATIC AND ATOMIC BLAST LOADINGS, OPERATION TEAPOT

WT-1204-EX                                                   800901       A U      0025      A995054        801795
ORG-AG SANDIA CORP                                               AUTHOR  INGERSOLL C E
TITLE  OPERATION TEAPOT, FEASIBILITY TEST OF A RADIO LINKED REMOTE ALPHA MEASURING SYSTEM, PROJECT 14.28, EXTRACTED VERSION

WT-1206-EX                                                   800901       A U      0278      A995106        810854
ORG-AG SPECIAL WEAPONS CENTER, AF                                AUTHOR  FACKLER P H
TITLE  OPERATION TEAPOT, TECHNICAL AIR OPERATIONS, EXTRACTED VERSION

WT-1208-EX                                                   800901       A U      0038      A995056        801793
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                 AUTHOR  STORM E
TITLE  OPERATION TEAPOT, GAMMA RADIATION AS A FUNCTION OF DISTANCE, PROJECT 13.3A, EXTRACTED VERSION

WT-1212                                                      560300       A U      0089      132885         019569
ORG-AG DEPARTMENT OF HEALTH EDUCATION AND WELFARE                AUTHOR
TITLE  OPERATION TEAPOT, EFFECTS OF NUCLEAR EXPLOSIONS ON CANNED FOODS

WT-1213                                                      560300        U       0018      611316         019570
ORG-AG DEPARTMENT OF HEALTH EDUCATION AND WELFARE                AUTHOR  MCCONNELL R E
TITLE  EFFECT OF NUCLEAR EXPLOSIONS ON COMMERCIALLY PACKAGED BEVERAGES

WT-1214                                                      560200        U       0059      611315         019571
ORG-AG DEPARTMENT OF HEALTH EDUCATION AND WELFARE                AUTHOR  HARDENBURG R E
TITLE  EFFECT OF NUCLEAR EXPLOSIONS ON SEMIPERISHABLE FOODS AND FOOD PACKAGING

WT-1215                                                      570111       A U      0017      611228         019572
ORG-AG FOOD AND DRUG ADMIN                                       AUTHOR  LAUG ROBERT L
TITLE  EFFECTS OF NUCLEAR EXPLOSIONS ON FROZEN FOODS

WT-1216                                                      560400        U       0041      611329         019573
ORG-AG DEPARTMENT OF HEALTH EDUCATION AND WELFARE                AUTHOR  PHILBECK R H
TITLE  EFFECT OF NUCLEAR EXPLOSIONS ON MEAT AND MEAT PRODUCTS
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        PRI-RPT                       SEC-RPT            ORG-DT     H-CLASS     PG-LF      DDC-AD-NO      DTL-NO

WT-1217                                                  560300       A U       0034       A995051        019574
ORG-AG LOVELACE FOUNDATION FOR MEDICAL EDUC AND RES          AUTHOR  BOWEN I G
TITLE  DISTRIBUTION AND DENSITY OF MISSILES FROM NUCLEAR EXPLOSIONS

WT-1218                                                  560300        U        0122       A073524        019575
ORG-AG SANDIA LABS                                           AUTHOR  VORTMAN L J
TITLE  EVALUATION OF VARIOUS TYPES OF PERSONNEL SHELTERS EXPOSED TO AN ATOMIC EXPLOSION

WT-1220                                                  560600       A U       0038       A995037        019576
ORG-AG EG AND G INC                                          AUTHOR
TITLE  PHOTONEPHOGRAPHY

WT-1222                                                  560500       A U       0019       611327         019578
ORG-AG DEPARTMENT OF HEALTH EDUCATION AND WELFARE            AUTHOR  LANG E P
TITLE  EXPOSURE OF FOODS AND FOODSTUFF TO NUCLEAR EXPLOSIONS (A SUMMARY OF RESULTS)

WT-1225                                                  591028       A U       0098       460282         019581
ORG-AG NAVAL RADIOLOGICAL DEFENSE LABORATORY                 AUTHOR  MATHER R L
TITLE  GAMMA RADIATION FIELD ABOVE FALLOUT CONTAMINATED GROUND

WT-1226                                                  570500       A U       0045       B951726        019582
ORG-AG EDGERTON, GERMESHAUSEN & GRIER, INC.                  AUTHOR
TITLE  TIMING AND FIRING, REPORT TO THE TEST DIRECTOR, OPERATION TEAPOT PROJECT 10.0

WT-1228                                                  570900        U        0026       A995038        019584
ORG-AG COLUMBIA UNIV. RADIOLOGICAL RES LAB                   AUTHOR  ROSSI H H
TITLE  IONIZATION CHAMBER DOSE MEASUREMENTS IN LEAD HEMISPHERES, REPORT TO THE TEST DIRECTOR, OPERATION TEAPOT

WT-1229                                                  590227       A U       0016       A995010        019585
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                        AUTHOR  PLUM W B
TITLE  IRRADIANCE MEASUREMENTS WITH TIME RESOLUTION
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AFSWI
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                  800201       A U       0046      A995022        801212
TITLE  OPERATION WIGWAM CONCEPT, EXTRACTED VERSION                AUTHOR

CTG-7.3
ORG-AG COMMANDER TASK GROUP 7.3                              800201       A U       0064      A995001        801037
TITLE  OPERATION WIGWAM, REPORT OF COMMANDER, TASK GROUP 7.3, EXTRACTED VERSION
                                                                  AUTHOR

ITR-1055
ORG-AG NAVAL ORDNANCE LAB                                    550500       A U       0055      B951584        019346
TITLE  UNDERWATER FREE FILEC PRESSURES TO JUST BEYOND TARGET LOCATIONS
                                                                  AUTHOR  ARONSON C J

ITR-1056
ORG-AG NAVAL RESEARCH LABORATORY                             550500       A U       0030      B951590        019344
TITLE  FREE-FIELD PRESSURES, ZERO STATION                         AUTHOR  WALSH J

ITR-1057
ORG-AG NAVY ELECTRONICS LAB                                  550500       A U       0038      A995114        019342
TITLE  FREE FIELD PRESSURE MEASUREMENTS, OPERATION WIGWAM PRELIMINARY REPORT, PROJECT 1.3
                                                                  AUTHOR  MCMILLIAN

ITR-1058
ORG-AG NAVAL ORDNANCE LABORATORY                             550500       A U       0014      B951579        019340
TITLE  BUBBLE PHENOMENA                                           AUTHOR  HAMILTON G

ITR-1059
ORG-AG NAVAL ORDNANCE LABORATORY                             550500       A U       0038      B951580        019338
TITLE  PHOTOGRAPHIC MEASUREMENTS OF A SURFACE PHENOMENA           AUTHOR  YOUNG G

ITR-1064
ORG-AG SCRIPPS INST OF OCEANOGRAPHY                          550500       A U       0026      B951582        019362
TITLE  MECHANISM AND EXTENT OF THE EARLY DISPERSION OF RADIOACTIVE PRODUCTS IN WATER
                                                                  AUTHOR  FOLSOM T R

ITR-1070
ORG-AG DAVID TAYLOR MODEL BASIN, NAVY                        550500       A U       0042      A995042        019350
TITLE  APPLIED PRESSURES ON AND HULL RESPONSE OF WIGWAM TARGETS   AUTHOR  CHERTOCK G

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ITR-1072                                                         550501        A U         0035         B951720          019348
ORG-AG DAVID TAYLCR PCDEL BASIN                                       AUTHOR  RICH H
TITLE  HULL RESPONSE AND SFCCK PCTICN

ITR-1073                                                         550500        A U         0046         B951721          019377
ORG-AG NAVAL RESEARCF LABCRATCRY                                      AUTHOR  BLAKE R
TITLE  SHOCK SPECTRUM MEASUREMENTS ON YFAB AND SCUAW TARGETS

ITR-1075                                                         550500        A U         0030         B951722          019374
ORG-AG DAVID TAYLCR PODEL BASIN                                       AUTHOR  RICH H
TITLE  FIGH SPEED PHCTOGRAPHY OF INTERIOR OF WIGWAM TARGETS

ITR-1077                                                         550500        A U         0023         A078557          019385
ORG-AG BUREAU OF SHIPS                                                AUTHOR  HARTER J R R
TITLE  EXTERIOR DAPAGE PFCTCGRAPHY OF SUBMERGED TARGETS, OPERATION WIGWAM

ITR-1078                                                         550500        A U         0026         B951723          019372
ORG-AG CAVID TAYLCR MODEL BASIN                                       AUTHOR  RICH H
TITLE  DEPTH, TRIM, FEADING, AND FLOCDING OF WIGWAM TARGETS

ITR-1082                                                         550500        A U         0032         B951593          019367
ORG-AG ILLINCIS INSTITUTE OF TECHNOLOGY                               AUTHOR  PORZEL F
TITLE  CLOSE IN TIME OF ARRIVAL OF UNDERWATER SHCCK WAVE

ITR-1083                                                         550500        A U         0024         B951594          019365
ORG-AG SANDIA LABS                                                    AUTHOR  MERRITT M L
TITLE  AIR PRESSURES FRCP A CEEP UNDERWATER BURST

ITR-1086                                                         550500        A U         0020         B951591          019384
ORG-AG OFFICE OF NAVAL RES                                            AUTHOR  THALER W J
TITLE  UNDERWATER OPTICAL MEASUREPENTS

JAYCOR-2087-79-02               DNA-6000F                        810901        A U         0262         A105685          811396
ORG-AG JAYCCR                                                         AUTHOR  WEARY S E
TITLE  OPERATION WIGWAP, SERIES VCLUME

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JAYCOR-2087-79-2              DNA-6000F                      800530        A U      0248       A085776        800907
ORG-AG JAYCOR                                                      AUTHOR  WEARY S E
TITLE  PROTOTYPE REPORT, DOD PERSONNEL PARTICIPATION OPERATION WIGWAM, SERIES VOLUME, OCEANIC TEST, FIRST EDITION

NOLR-1213                     WT-1004                        000000        A U      0074       338338         019326
ORG-AG NAVAL ORDNANCE LAB                                          AUTHOR  SNAY H G
TITLE  PREDICTIONS OF UNDERWATER EXPLOSION PHENOMENA, REPORT TO THE SCIENTIFIC DIRECTOR

NOLR-1215                     WT-1005                        560500        A U      0254       338339         019345
ORG-AG NAVAL ORDNANCE LAB                                          AUTHOR  ARONSON C J
TITLE  UNDERWATER FREE FIELD PRESSURES TO JUST BEYOND TARGET LOCATIONS

NOLR-1217                     WT-1009                        000000        A U      0106       361918         019337
ORG-AG NAVAL ORDNANCE LAB                                          AUTHOR  YOUNG G A
TITLE  PHOTOGRAPHIC MEASUREMENTS OF SURFACE PHENOMENA, REPORT TO THE SCIENTIFIC DIRECTOR

NRDL-TR-981                                                  660228        A U      0047       481165         012907
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                              AUTHOR  KEHRER W J
TITLE  AERIAL SURVEY OF THE CONTAMINATED OCEAN SURFACE AT OPERATION WIGWAM, WITH DOSE RATE CONTOUR LINES THROUGH D+4 DAYS

TG-7.3-OP-1-55                                               550325        A U      0132       A078579        019380
ORG-AG JOINT TASK FORCE 7                                          AUTHOR
TITLE  OPERATION WIGWAM, TASK GROUP 7.3, OPERATION PLAN 1-55

WT-1001                                                      570100        A U      0100       337571         019329
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                              AUTHOR  BAIETTI A L
TITLE  RADIOLOGICAL SAFETY FOR OPERATION WIGWAM

WT-1003-EX                                                   800201        A U      0184       A995030        801440
ORG-AG CALIFORNIA. UNIV                                            AUTHOR
TITLE  OPERATION WIGWAM, SCIENTIFIC DIRECTORS SUMMARY REPORT, EXTRACTED VERSION

WT-1006                                                      550500        A U      0074       339495         019343
ORG-AG NAVAL RES LAB                                               AUTHOR
TITLE  FREE FIELD PRESSURES, STATION ZERO

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WT-1007                                                         550500         A U       0046        338544          019341
ORG-AG NAVAL ELECTRCNICS LAB                                          AUTHOR  MCMILLIAN T
TITLE  UNDERWATER FREE FIELC PRESSURE MEASUREMENTS


WT-1008                                                         560300         A U       0034        338012          019339
ORG-AG NAVAL ORDNANCE LAB                                             AUTHOR  ARONSON C J
TITLE  BUBBLE PHEACMENA


WT-1010-EX                                                      000201         A U       0012        B951748         000959
ORG-AG NAVAL RES LAB                                                  AUTHOR
TITLE  OPERATICN WIGWAM, PRCJECT 2.2, RADIOCHEMICAL ANALYSIS OF WIGWAM DEBRIS, EXTRACTED VERSION


WT-1011-EX                                                      000201         A U       0063        A995018         001151
ORG-AG COMMANDER TASK GRCUP 7.3                                       AUTHOR
TITLE  OPERATION WIGWAM, PROJECT 2.3, RADIOCHEMICAL AND PHYSICAL CHEMICAL PROPERTIES OF PRODUCTS OF A DEEP UNDERWATER NUCLEAR D
       ETONATION, EXTRACTED VERSICN


WT-1012                                                         560700         A U       0102        465308          019332
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                 AUTHOR  HAWKINS F B
TITLE  DETERMINATION OF RADICLOGICAL HAZARD TO PERSONNEL


WT-1013                                                         560800         A  U      0156        613617          019363
ORG-AG SCRIPPS INSTITUTICN CF OCEANOGRAPHY                            AUTHOR  SCHAEFER M
TITLE  EFFECTS OF NUCLEAR EXPLCSICN CN MARINE BICLOGY


WT-1014                                                         620328         A  U      0056        445669          019361
ORG-AG SCRIPPS INSTITUTICN CF OCEANOGRAPHY                            AUTHOR  ISAACS J
TITLE  MECHANISM AND EXTENT CF THE EARLY DISPERSION OF RADIOACTIVE PRODUCTS IN WATER


WT-1015                                                         561217         A U       0058        465309          019360
ORG-AG SCRIPPS INST OF OCEANCGRAPHY                                   AUTHOR  FOLSOM T
TITLE  MECHANISF AND EXTENT CF THE DISPERSION OF FISSION PRODUCTS BY OCEANCGRAPHIC PROCESSES AND LOCATING AND MEASURING SURFACE
         AND UNDERWATER RADIOACTIVF CCNTAMINATION


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WT-1016                                                         580130        A U        0036       460279         019359
ORG-AG SCRIPPS INST OF OCEANOGRAPHY                                  AUTHOR  FOLSOM T
TITLE  RADIOLOGICAL TECHNIQUES AND INSTRUMENTS USED FOR THE OCEANOGRAPHIC SURVEY ON OPERATION WIGWAM

WT-1017                                                         550500        A U        0027       617135         019357
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                AUTHOR  FRENCH F A
TITLE  FALLOUT AND AIRBORNE ACTIVITY IN OPERATION WIGWAM, WITH NOTES ON SURFACE EFFECTS

WT-1018                                                         550500        A U        0026       224418         019355
ORG-AG SCRIPPS INST OF OCEANOGRAPHY                                  AUTHOR  HORRER P L
TITLE  SUBSURFACE CONFIGURATION OF THE ARRAY

WT-1019                                                         550500        A U        0042       611252         019353
ORG-AG SCRIPPS INSTITUTION OF OCEANOGRAPHY                           AUTHOR  HORRER P L
TITLE  PHYSICAL OCEANOGRAPHY OF THE TEST AREA

WT-1020                                                         590731        A U        0038       361917         019351
ORG-AG SCRIPPS INSTITUTION OF OCEANOGRAPHY                           AUTHOR  KIDD L
TITLE  MEASUREMENTS OF SECONDARY EFFECTS:  WATER WAVES

WT-1021                                                         560400        A U        0090       361916         019349
ORG-AG DAVID TAYLOR MODEL BASIN                                      AUTHOR  CHERTOCK G
TITLE  LETHAL RANGE OF WIGWAM TARGETS BASED ON HULL RESPONSE AND APPLIED PRESSURE MEASUREMENTS

WT-1023                                                         560400        A U        0090       361915         019347
ORG-AG DAVID TAYLOR MODEL BASIN. NAVY                                AUTHOR  RICH H L
TITLE  HULL RESPONSE AND SHOCK MOTION-BACKGROUND, INSTRUMENTATION, AND TEST RESULTS, PART 1

WT-1024                                                         570318        A U        0060       338555         019378
ORG-AG DAVID TAYLOR MODEL BASIN                                      AUTHOR  RICH H
TITLE  HULL RESPONSE AND SHOCK MOTION - DISCUSSION AND ANALYSIS

WT-1025                                                         560600        A U        0030       338005         019376
ORG-AG NAVAL RES LAB                                                 AUTHOR  BLAKE R E
TITLE  SHOCK MOTION OF YFNB TARGETS


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WT-1026                                                        550500         A U        0044       361914           019375
ORG-AG DAVID TAYLOR MODEL BASIN                                      AUTHOR  PALADINO A
TITLE  VIBRATION CHARACTERISTICS OF CERTAIN ITEMS ON SQUAW-29, YFNB-29, AND PAPOOSE C

WT-1027                                                        550500         A U        0034       361913           019373
ORG-AG DAVID TAYLOR MODEL BASIN, NAVY                                AUTHOR  ATCHISON C M
TITLE  RESPONSE OF SQUAW TARGETS FROM HIGH SPEED MOTION PICTURES OF INTERIOR

WT-1030                                                        550500         A U        0030       361920           019371
ORG-AG DAVID TAYLOR MODEL BASIN, NAVY                                AUTHOR  CONVERSE R E
TITLE  DEPTH, TRIM, HEADING, AND FLOODING OF WIGWAM TARGETS

WT-1031                                                        550500         A U        0076       361912           019370
ORG-AG LONG BEACH NAVAL SHIPYARD                                     AUTHOR  ROSS W
TITLE  DESIGN AND CONSTRUCTION OF WIGWAM TARGETS

WT-1032                                                        550500         A U        0033       465310           019369
ORG-AG NAVAL ELECTRONICS LAB                                         AUTHOR  SHELLABARGER J N
TITLE  MODIFICATION AND OUTFITTING OF INSTRUMENT BARGES

WT-1033-EX                                                     800201         A U        0020       B951738          800912
ORG-AG COMMANDER TASK FORCE 7.3 .                                    AUTHOR
TITLE  OPERATION WIGWAM, PROJECT 4.1, EXTRACTED VERSION

WT-1034                                                        560600         A U        0114       361919           019366
ORG-AG ARMOUR RESEARCH FOUNDATION                                    AUTHOR  PORZEL F
TITLE  CLOSE-IN TIME OF ARRIVAL OF UNDERWATER SHOCK WAVE, REPORT TO THE SCIENTIFIC DIRECTOR, OPERATION WIGWAM PROJECT 4.4

WT-1035                                                        551200         A U        0020       330541           019364
ORG-AG SANDIA CORPORATION                                            AUTHOR  MERRITT M
TITLE  AIR PRESSURES FROM A DEEP UNDERWATER BURST

WT-1036                                                        550700         A U        0061       361831           019392
ORG-AG EG AND G INC                                                  AUTHOR  WARCHOL M F
TITLE  TIMING AND FIRING, PROGRAM 5


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        PRI-RPT                      SEC-RPT                 ORG-DT     M-CLASS    PG-LF      DOC-AD-NO       DTL-NO

WT-1037                                                      560600       A U      0013       8951719         019391
ORG-AG LOOKOUT MOUNTAIN LAB                                         AUTHOR  ALBERT H
TITLE  PHOTOGRAPHIC SERVICES FOR OPERATION WIGWAM, PROGRAM 6

WT-1038                                                      550500       A U      0035       357958          019390
ORG-AG NAVY ELECTRONICS LABORATORY                                  AUTHOR  BOLORICK E H
TITLE  PHOTOGRAPHIC RECORDING OF SHIP-BORNE RADAR INFORMATION

WT-1039                                                      570327       A U      0019       361921          019388
ORG-AG CALIFORNIA. UNIV                                             AUTHOR  VAN DORN W G
TITLE  COLLECTION OF EARLY WATER SAMPLES FOR RADIOCHEMICAL ANALYSIS AND YIELD DETERMINATION

WT-1040-EX                                                   800201       A U      0010       8951739         800897
ORG-AG SANDIA CORP                                                  AUTHOR
TITLE  OPERATION WIGWAM, PROJECT 4.2, WEAPONSS ASSEMBLY, EXTRACTED VERSION
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       PRI-RPT                        SEC-RPT                ORG-DT      H-CLASS      PG-LF       DOC-AD-NO        DTL-NO

CTG-7.2                                                      560731        A U         0189       A995079          800368
ORG-AG COMMANDER TASK GROUP 7.2                                  AUTHOR
TITLE  JOINT TASK FORCE 7 FINAL REPORT, OPERATION REDWING

CTG-7.3                                                      791001        A U         0196       B951765          800984
ORG-AG COMMANDER TASK GROUP 7.3                                  AUTHOR  WELLINGS J H
TITLE  OPERATION REDWING, COMMANDER TASK GROUP 7.3, FINAL REPORT, EXTRACTED VERSION

DNA                                                          810515        A U         0238       A995130          811650
ORG-AG DEFENSE NUCLEAR AGENCY, FIELD COMMAND                     AUTHOR  CAMPBELL D C
TITLE  OPERATION REDWING, PROGRAM 2, NUCLEAR RADIATION AND EFFECTS CONSOLIDATED PROGRAM BOOK, EXTRACTED VERSION

H-N                                                          560000        A U         0189       A995068          019729
ORG-AG HOLMES AND NARVER                                         AUTHOR
TITLE  COMPLETION REPORT OPERATION REDWING

JTF-7                                                        730608        A U         0090       B951592          019711
ORG-AG JOINT TASK FORCE SEVEN                                    AUTHOR  BLUMENSON H
TITLE  HISTORY OF OPERATION REDWING, THE ATOMIC WEAPONS TESTS IN THE PACIFIC 1956

JTF-7                                                        560000        A U         0209       A995058          009388
ORG-AG JOINT TASK FORCE SEVEN                                    AUTHOR  HANLON E
TITLE  METEOROLOGICAL REPORT ON OPERATION REDWING, PART 1 - METEOROLOGICAL DATA, VOLUME 3, KUSAIE

JTF-7                                                        570214        A U         0345       A995061          009395
ORG-AG JOINT TASK FORCE SEVEN                                    AUTHOR  HANLON E
TITLE  METEOROLOGICAL REPORT ON OPERATION REDWING, PART 1 - METEOROLOGICAL DATA, VOLUME 9, KAPINGAMARANGI

JTF-7.1-OO-1-56          J3-43C-EX                           820801        A U         0175       A995170          830005
ORG-AG JOINT TASK FORCE 7.1                                      AUTHOR  KERWIN W T
TITLE  OPERATION REDWING, TASK FORCE 7.1, OPERATION ORDER 1-56, EXTRACTED VERSION

JTF-7.3-OP-1-56                                              560424        A U         0287       A080272          019710
ORG-AG JOINT TASK FORCE 7                                        AUTHOR
TITLE  OPERATION REDWING, OPERATION PLAN 1-56


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       PRI-RPT                        SEC-RPT               ORG-DT      H-CLASS     PG-LF      DDC-AD-NO       DTL-NO

JTFMC-TP-1-P-V-12                                          570911        A U       0241      A995062          009598
ORG-AG JOINT TASK FORCE SEVEN                                     AUTHOR  HANLON E
TITLE  METEOROLOGICAL REPORT ON OPERATION REDWING, PART 1 - METEOROLOGICAL DATA, VOLUME 12, AIRCRAFT WEATHER RECONNAISSANCE


JTFMC-TP-1-P-1-V-5                                         560000        A U       0331      A995059          009391
ORG-AG JOINT TASK FORCE SEVEN                                     AUTHOR  HANLON E
TITLE  METEOROLOGICAL REPORT ON OPERATION REDWING, PART 1 - METEOROLOGICAL DATA, VOLUME 5, PUNAPE


JTFMC-TP-1-V-7                                             56C000        A U       0200      A995060          009393
ORG-AG JOINT TASK FORCE SEVEN                                     AUTHOR  HANLON B
TITLE  METEOROLOGICAL REPORT ON OPERATION REDWING, PART 1 - METEOROLOGICAL DATA, VOLUME 7, MAJURO


MC                                                         810601        A U       0139      A995151          820767
ORG-AG MARINE CORPS                                               AUTHOR  BEARER J F
TITLE  OPERATION REDWING TYPE E REPORT, EXTRACTED VERSION


NRDL-TR-139                                                570403          U       0059      133541           012531
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                             AUTHOR  SCHUBERT E A
TITLE  FALLOUT FORECASTING TECHNIQUE WITH RESULTS OBTAINED AT THE  ENIWETOK PROVING GROUND


NRDL-TR-152                                                570328        A U       0036      144368           012539
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                             AUTHOR  WILLIAMSON W
TITLE  INVESTIGATION AND CORRELATION OF SOME PHYSICAL PARAMETERS OF FALLOUT MATERIAL


NRDL-TR-161                                                570601        A U       0027      153820           012548
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                             AUTHOR  BIGGER M M
TITLE  GENERAL DESCRIPTION OF TEST SHIPS YAG-39 YAG-40 AND LIST-611


NRDL-TR-314                                                590212          U       0071      233607           012628
ORG-AG NEWMARK HANSEN AND ASSOCIATES                              AUTHOR  CHAN H K
TITLE  ACTIVITY-SIZE RELATIONSHIP OF FALLOUT PARTICLES FROM TWO    SHOTS, OPERATION REDWING


NRDL-TR-331-EX                                             810515        A U       0152      A995131          811651
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                             AUTHOR  DAY R P
TITLE  MEASUREMENT OF THERMAL RADIATION INCIDENT ON NAVAL AIRCRAFT IN FLIGHT AT OPERATIONS REDWING, PLUMBBOB AND HARDTACK, EXTR
       ACTED VERSION
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NRDL-TR-364
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                      590924       A U        0026      229280        012659
                                                                 AUTHOR  SCHELL W R
TITLE  IDENTIFICATICN OF MICRCN-SIZED, INSOLUBLE-SOLIDS FALLOUT PARTICLES COLLECTED DURING OPERATION REDWING

WT-1301-EX
ORG-AG BALLISTIC RES LABS. ARMY                            810515       A U        0112      A995110       811034
                                                                 AUTHOR  KINGERY C N
TITLE  OPERATION REDWING, GRCUND SURFACE AIR BLAST PRESSURE VERSUS DISTANCE, PROJECT 1.1, EXTRACTED VERSION

WT-1303-EX
ORG-AG NAVAL ORDNANCE LAB                                  810101       A U        0042      A995089       810725
                                                                 AUTHOR  BELLIVEAU L J
TITLE  OPERATION REDWING, AIR BLAST AND SHOCK PHENOMENA BY PHOTOGRAPHY, PROJECT 1.3, EXTRACTED VERSION

WT-1306
ORG-AG NAVAL ORDNANCE LABCRATORY                           591204       A U        0124      357969        019605
                                                                 AUTHOR . PETES J
TITLE  DRAG LOADING CN MCDEL TARGETS

WT-13C7-EX
ORG-AG ARMED FORCES SPECIAL WEAPCNS PROJECT                810101       A U        0037      A995097       810796
                                                                 AUTHOR  LEWIS J G
TITLE  OPERATION REDWING, PRCJECT 1.8, CRATER MEASUREMENTS, EXTRACTED VERSION

WT-1308-EX
ORG-AG SCRIPPS INST CF CCEANCGRAPHY                        810515       A U        0030      A995111       811035
                                                                 AUTHOR  VAN DORN W G
TITLE  OPERATION REDWING, INDIRECT WATER WAVES FROM LARGE YIELD BURSTS, PROJECT 1.9B, EXTRACTED VERSION

WT-1310-EX
ORG-AG DEFENSE ATCMIC SUPPCRT AGENCY                       810401       A U        0043      A995100       810797
                                                                 AUTHOR  BROWN P
TITLE  OPERATION REDWING, PRCJECT 2.1, GAMMA EXPCSURE VERSUS DISTANCE,  EXTRACTED VERSION

WT-1311-EX
ORG-AG SIGNAL RES AND DEVELCP LAB. ARMY                    810515       A U        0054      A995112       811033
                                                                 AUTHOR  BROWN P
TITLE  CPERATION REDWING, GAMMA EXPCSURE RATE VERSUS TIME, PROJECT 2.2, EXTRACTED VERSION

WT-1312
ORG-AG CHEMICAL WARFARE LABS. ARMY                         570400       A U        0026      357965        019616
                                                                 AUTHOR
TITLE  DECONTAMINATICN AND PROTECTICN, CPERATION REDWING

                                          UNCLASSIFIED
       PRI-RPT                         SEC-RPT              ORG-DT      H-CLASS      PG-LF      DDC-AD-NO       DTL-NO

WT-1313-EX                                                  810515        A U        0070       A995142         820573
ORG-AG CHEMICAL WARFARE LABS, ARMY                                  AUTHOR  LUKE C W
TITLE  OPERATICN REDWING, PRCJECT 2.51, NEUTRON FLUX MEASUREMENTS, EXTRACTED VERSICN

WT-1315-EX                                                  810515        A U        0052       A995113         810981
ORG-AG NAVAL RADICLOGICAL DEFENSE LAB                               AUTHOR  SOULE R R
TITLE  CPERATION RECWING, ROCKET DETERMINATION OF ACTIVITY DISTRIBUTION WITHIN THE STABILIZED CLOUD, PROJECT 2.61, EXTRACTED,VE
       RSION

WT-1316-EX                                                  800201        A U        0156       A995034         801492
ORG-AG CEFENSE ATOMIC SUPPCRT AGFNCY                                AUTHOR
TITLF  OPERATION REDWING, PROJECT 2.62A, FALLOUT STUDIES BY OCEANOGRAPHIC METHODS, EXTRACTED VERSION

WT-1318-EX                                                  810101        A U        0076       A995090         810726
ORG-AG CEFENSE ATOMIC SUPPORT AGENCY, FIELD COMMAND                  AUTHOR  GRAVESON R T
TITLE  OPERATION RECWING, FALLCUT LOCATION AND DELINEATION BY AERIAL SURVEYS, PROJECT 2.64, EXTRACTED VERSION

WT-1321                                                     561000        A U        0092       357967          019632
ORG-AG NAVAL RADICLOGICAL DEFENSE LAB                               AUTHOR  RINNERT H R
TITLE  SHIP SHIELDING STLDIES

WT-1322                                                     590130        A U        0086       362109          019634
ORG-AG NAVAL RADICLOGICAL DEFENSE LAB                               AUTHOR
TITLE  SHIPBOARD RADIOLCGICAL CCUNTERMEASURE METHODS

WT-1323                                                     590320        A U        0046       357962          019635
ORG-AG NAVAL RADICLOGICAL DEFENSE LAB                               AUTHOR  VINE F S
TITLE  STANDARD RECOVERY PRCCEDURE FCR TACTICAL CECONTAMINATION OF SHIPS, OPERATION REDWING

WT-1324                                                     590212        A U        0058       357963          019637
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                               AUTHOR
TITLE  VERIFICATICN CF SHIPBCARC WASHDOWN CCUNTERMEASURE, OPERATION REDWING
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       PRI-RPT                      SEC-RPT                ORG-DT      H-CLASS     PG-LF      DOC-AD-NO       DTL-NO

WT-1344-EX                                                 810515        A U       0270      A995132         820184
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY, FIELD COMMAND               AUTHOR
TITLE  OPERATION REDWING, TECHNICAL SUMMARY OF MILITARY EFFECTS, PROGRAMS, 1-9, EXTRACTED VERSION


WT-1349                                                    600421        A  U      0090      361977          019683
ORG-AG SCRIPPS INSTITUTION OF OCEANOGRAPHY                        AUTHOR  JENNINGS F
TITLE  BACKGROUND RADIOACTIVITY AND OCEANOGRAPHIC CONDITIONS


WT-1359-EX                                                 791001        A U       0163      A995026         801427
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                  AUTHOR  ALLEN H S
TITLE  OPERATION REDWING, REPORT OF THE COMMANDER TASK GROUP 7.1, EXTRACTED VERSION


WT-1364-EX                                                 820604        A U       0056      A995168         820788
ORG-AG SANDIA LABS                                                AUTHOR  PERRET W R
TITLE  OPERATION REDWING, REPORT TO THE SCIENTIFIC DIRECTOR, ADJUNCT TO PROJECT 30.2, GROUND MOTION STUDIES, EXTRACTED VERSION


WT-1366-EX                                                 800701        A U       0044      A995027         801428
ORG-AG LOS ALAMOS SCIENTIFIC LAB                                  AUTHOR  JACKS G L
TITLE  OPERATION REDWING RADIOLOGICAL SAFETY, EXTRACTED VERSION


WT-1369-EX                                                 810515        A U       0148      A995150         820768
ORG-AG SCRIPPS INSTITUTION OF OCEANOGRAPHY                        AUTHOR  KIDD L W
TITLE  OPERATION REDWING, PROJECT 1.9A, DIRECT WATER WAVE MEASUREMENTS, EXTRACTED VERSION
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         PRI-RPT                                 SEC-RPT                  ORG-DT       H-CLASS      PG-LF       DDC-AD-NO        DTL-NO
AEC
ORG-AG ATOMIC ENERGY COPPISSION                                           800201         A U        0479       A995083          810594
TITLE  OPERATION PLUMBBCE, REPCRT OF TEST MANAGER, EXTRACTED VERSION          AUTHOR

AEC
ORG-AG ATOMIC ENERGY CCPPISSICN                                           570601         A U        0029       A080273          019928
TITLE  CONTINENTAL ATCMIC TESTS, BACKGRCUND INFORMATION FOR                    AUTHOR
                                                                              OBSERVERS, SUMMER 1957

AFSWC
ORG-AG 4950TH TEST GROUP (NUCLEAR). AF                                    800301         A U        0139       A995031          801487
TITLE  OPERATION PLUMBBOB OPERATION PLAN 1-57, EXTRACTED VERSION              AUTHOR

AFSWC
ORG-AG SPECIAL WEAPCNS CENTER. AF                                         801201         A U        0168       A995104          810819
TITLE  OPERATION PLUMBBCB, 4950TH TEST GROUP (N), FINAL REPORT, EXTRACTED VERSION
                                                                              AUTHOR

AG-S-9531
ORG-AG DEPARTMENT OF THE ARMY                                             571125           U        0059       A077515          007457
TITLE  EXERCISE DESERT RCCK 7 AND 8, FINAL REPORT OF OPERATIONS               AUTHOR

AMGCT-4-381
ORG-AG SIXTH ARMY                                                         580122         A U        0119       A075358          771478
TITLE  EXERCISE DESERT RCCK 7 AND 8, REPCRT OF TEST INFANTRY                  AUTHOR
                                                                              TROOP TEST

ARMY-6TH
ORG-AG SIXTH. ARMY                                                        570327         A U        0031       A995041          791489
TITLF  DIRECTIVE FOR EXERCISE DESERT ROCK 7 AND 8                             AUTHOR

ASRD-TR-2058
ORG-AG SIGNAL RES AND DEVELCPMENT LAB. ARMY                               600815         A U        0075       252267           007658
TITLE  OPERATIONS OF THE FALLOUT GROUP CF PROJECT 50.3, OPERATION PLUMBBOB    AUTHOR  RICHARDS W J

ASRDL-TR-2021-EX
ORG-AG SIGNAL RES AND DEVELCPMENT LAB. ARMY                               791001         A U        0144       A995052          801494
TITLE  TEST OF DETCNATICN LCCATCR SYSTEM AN/GSS-4, OPERATION PLUMBBOB, DESERT ROCK 7 AND 8, PROJECT 50.3, EXTRACTED VERSION
                                                                              AUTHOR  KOWALSKI R T

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        PRI-RPT                              SEC-RPT                     ORG-DT      H-CLASS    PG-LF      DDC-AD-NO      DTL-NO
ASRDL-TR-2077
ORG-AG SIGNAL ENGINEERING LABS. ARMY                                     591102        A U      0050       344156         007656
TITLE  RADAR DETECTION AND OBSERVATION OF NUCLEAR CLOUDS, PART 2 - PROJECT 50.3, DESERT ROCK 7 AND 8, OPERATION PLUMBBOB
                                                                             AUTHOR  BASTIAN C W

BRL
ORG-AG BALLISTIC RES LABS. ARMY                                          570401        A U      0000       A995040        004852
TITLE  U.S. ARMY ORDNANCE PARTICIPATION IN EXERCISE DESERT ROCK 7 AND 8 (U)
                                                                             AUTHOR

CDR
ORG-AG CAMP DESERT ROCK. ARMY                                            570511        A U      0045       A080266        800085
TITLE  EXERCISE DESERT ROCK 7, OPERATION ORDER 1                             AUTHOR

CDR
ORG-AG CAMP DESERT ROCK. ARMY                                            570521        A U      0006       A080268        800084
TITLE  EXERCISE DESERT ROCK 7, OPERATION ORDER 3                             AUTHOR

CDR
ORG-AG CAMP DESERT ROCK. ARMY                                            570529        A U      0026       A080259        800083
TITLE  EXERCISE DESERT ROCK 7 AND 8, OPERATION ORDER 4                       AUTHOR

CDR
ORG-AG CAMP DESERT ROCK. ARMY                                            570000        A U      0016       A080258        800082
TITLE  EXERCISE DESERT ROCK, GENERAL ORDERS 2 THRU 16                        AUTHOR

CDR
ORG-AG CAMP DESERT ROCK. ARMY                                            570000        A U      0025       A080257        800073
TITLE  EXERCISE DESERT ROCK, STAFF MEMORANDUMS                               AUTHOR

CDR
ORG-AG CAMP DESERT ROCK. ARMY                                            570000        A U      0055       A080256        800074
TITLE  EXERCISE DESERT ROCK LETTER ORDERS                                    AUTHOR

CDR
ORG-AG CAMP DESERT ROCK. ARMY                                            570000        A U      0008       A080255        800075
TITLE  EXERCISE DESERT ROCK 7, MOVEMENT ORDER 1 THRU 3                       AUTHOR

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        PRI-RPT                          SEC-RPT              ORG-DT       H-CLASS      PG-LF       DOC-AD-NO        DTL-NO

CDR                                                           570515          A U        0047        AD80267          800086
ORG-AG CAMP DESERT ROCK. ARPY                                       AUTHOR
TITLE  EXFRCISE DESERT RCCK 7, CPERATION ORDER 2

CDR                                                           000000          A U        0125        AD80236          800072
ORG-AG CAMP DESERT ROCK. ARPY                                       AUTHOR
TITLE  AFTER ACTICN REPCRT, CPERATICN PLUMBBOB, CESERT ROCK 7 AND 8

CDR                                                           570611          A U        0037        AD80260          800081
ORG-AG CAMP DESERT ROCK. ARPY                                       AUTHOR
TITLE  EXERCISE DESERT ROCK 7 AND 8, OPERATION ORDER 5

CDR                                                           570710          A U        0011        AD80252          800078
ORG-AG CAMP DESERT ROCK. ARMY                                       AUTHOR
TITLE  EXERCISE DESERT RCCK 7 AND 8, OPERATION ORDER 10

CDR                                                           570724          A U        0027        AD80254          800076
ORG-AG CAMP DESERT ROCK. ARMY                                       AUTHOR
TITLE  FXERCISE DESERT RCCK 7 AKC 8, OPERATION ORDER 12

CDR                                                           570623          A U        0033        AD80250          800080
ORG-AG CAMP DESERT RCCK. ARPY                                       AUTHOR
TITLE  EXERCISE DESERT RCCK 7 AND 8, OPERATION ORDER 6

CDR                                                           570708          A U        0058        AD80251          800079
ORG-AG CAMP DESERT RCCK. ARPY                                       AUTHOR
TITLE  EXFRCISE DESERT RCCK 7 AND 8, OPERATION ORDER 9

CDR                                                           570725          A U        0022        AD80253          800077
ORG-AG CAMP DESERT ROCK. ARMY                                       AUTHOR
TITLE  EXERCISE DESEPT RCCK 7 ANC 8, OPERATION ORDER 11

CDR-MEMO-10                                                   570507          A U        0010        AD78544          791529
ORG-AG CAMP DESERT RCCK. ARPY                                       AUTHOR
TITLE  RADICLOGICAL SAFETY CPERATICNS
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      PRI-RPT                       SEC-RPT            ORG-DT    H-CLASS    PG-LF     DOC-AD-NO     DTL-NO

CETG                                                   570000      A U      0071      B951587       019927
ORG-AG CIVIL EFFECTS TEST OPERATIONS, AEC                      AUTHOR  CORSBIE R L
TITLE  OPERATION PLUMBBOB, CIVIL EFFECTS TEST GROUP PROJECT SUMMARIES, 1957

CTDN-22-EX                                             800201      A U      0019      A995053       801792
ORG-AG ALBUQUERQUE OPERATIONS OFFICE, AEC                      AUTHOR
TITLE  OPERATION PLUMBBOB TEST DIRECTORS OPERATION PLAN, EXTRACTED VERSION

DESERT-ROCK-OO-17                                      570800      A U      0049      A995039       791487
ORG-AG CAMP DESERT ROCK, ARMY                                  AUTHOR
TITLE  DESERT ROCK 7 AND 8, OPERATION ORDER 17 - SMOKY

DESERT-ROCK-7-8                                        571104        U      0112      A078561       007458
ORG-AG DEPARTMENT OF THE ARMY                                  AUTHOR
TITLE  ANNEX L TO FINAL REPORT EXERCISE DESERT ROCK 7 AND 8

ERDL-TR-1569-TR                                        590212      A U      0080      212440        007871
ORG-AG ENGINEER RES AND DEV LABS, ARMY                         AUTHOR  LOWE H N
TITLE  SOLUBILITY CHARACTERISTICS OF RADIOACTIVE BOMB DEBRIS IN WATER AND EVALUATION OF SELECTED DEONTAMINATION PROCEDURES

ERDL-1557-TR                                           581200      A U      0062      860811        021090
ORG-AG ENGINEER RES AND DEV LABS, ARMY                         AUTHOR  DAVIS N J
TITLE  PROTECTION AFFORDED BY FIELD FORTIFICATIONS AGAINST NUCLEAR WEAPONS EFFECTS

HUMRRO                                                 580300      A U      0087      A995069       800505
ORG-AG HUMAN RESOURCES RES ORGANIZATIONS                       AUTHOR  BALDWIN R D
TITLE  EXPERIENCES AT DESERT ROCK 8, STAFF MEMORANDUM

ITR-1402-EX                                            800201      A U      0030      B951745       800962
ORG-AG ARMED FORCES SPECIAL WEAPONS PROJECT                    AUTHOR
TITLE  OPERATION PLUMBBOB, PRELIMINARY REPORT FIELD TEST OF A SYSTEM FOR MEASURING BLAST PHENOMENA BY AIRBORNE GAGES, PROJECT 1
       .2, EXTRACTED VERSION
      PRI-RPT                      SEC-RPT                ORG-DT     H-CLASS     PG-LF      DOC-AD-NO        DTL-NO

ITR-1409                                                  571206        A U      0050      337904           019752
ORG-AG STANFORD RES INST                                       AUTHOR
TITLE  AIR BLAST PHENOMENA AS AFFECTED BY TERRAIN

ITR-1438-EX                                               800201        A U      0078      A995005          801035
ORG-AG CAMBRIDE RES CENTER. AF                                 AUTHOR  HOUGHTEN R A
TITLE  OPERATION PLUMBBOB, PRELIMINARY REPORT ACCURACY AND RELIABILITY OF A SHORT BASELINE NAROL SYSTEM, PROJECT 6.4, EXTRACTED
        VERSION

ITR-1442                                                  570920        A U      0016      A077501          019814
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                          AUTHOR  PLUM W B
TITLE  PERFORMANCE OF A HIGH SPEED SPECTROGRAPHIC SYSTEM

ITR-1476                                                  581020          U      0057      A077512          019858
ORG-AG TENNESSEE. UNIV                                         AUTHOR  KUHN U S G
TITLE  LARGE ANIMAL NEUTRON GAMMA IRRADIATION EXPERIMENT

ITR-1480                                                  581010          U      0041      A076369          019861
ORG-AG FEDERAL CIVIL DEFENSE ADM                               AUTHOR  TOLAN J H
TITLE  EVALUATION OF CIVIL DEFENSE RADIOLOGICAL INSTRUMENTS

ITR-1484                                                  571111        A U      0042      A995067          019864
ORG-AG FEDERAL CIVIL DEFENSE ADMINISTRATION                    AUTHOR  LOBDELL M
TITLE  RADIOLOGICAL DEFENSE OPERATIONS PHOTOGRAPHY, OPERATION PLUMBBOB PROJECT 36.6

ITR-1492                                                  570900        A U      0018      A078543          019871
ORG-AG CALIFORNIA. UNIV                                        AUTHOR  CASSEN B
TITLE  MEASUREMENTS AND PERMANENT RECORDING OF FAST NEUTRONS BY EFFECTS ON GERMANIUM DOSIMETERS

ITR-1502                                                  580523        A U      0038      A078822          019883
ORG-AG ATOMIC ENERGY COMMISSION                                AUTHOR  GRIEG A L
TITLE  THERMAL RADIATION MEASUREMENTS, PARTS 1 AND 2
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        PRI-RPT                       SEC-RPT                  ORG-DT    H-CLASS    PG-LF    DDC-AD-NO    DTL-NO

ITR-1515-EX                                                    820604      A U      0099     A995165      820786
ORG-AG SANDIA CORP                                                 AUTHOR  SHREVE J D
TITLE  OPERATION PLUPBBCB SUPNARY REPORT, TEST GROUP 57, EXTRACTED VERSION

ITR-1525                                                       570701      A U      0030     B951595      019906
ORG-AG ARMOUR RES FOUNCATICA                                       AUTHOR  BRITTAIN G H
TITLE  DOME STRUCTURE RESPONSE INSTRUMENTATION

JAYCOR-2087-79-01            DNA-6004F                         810531      A U      0156     A103828      811255
ORG-AG JAYCOR                                                      AUTHOR  HARRIS P S
TITLE  SHOT SMCKY, A TEST OF THE PLUMBBOB SERIES, 31 AUGUST 1957

JAYCOR-2087-79-02            CNA-6005F                         810915      A U      0312     A107317      811522
ORG-AG JAYCOR                                                      AUTHOR  HARRIS F S
TITLE  PLUMBBOB SERIES 1957

JRB-2-816-03-423-00          DNA-6002F                         810227      A U      0134     A101073      810887
ORG-AG JRB ASSOCIATES                                              AUTHOR  MAAG C
TITLE  SHOT HOOD, A TEST OF THE PLUMBBOB SERIES, FINAL REPORT

JRB-2-816-03-423-00          CNA-6003F                         810227      A U      0104     A105674      811386
ORG-AG JRB ASSOCIATES                                              AUTHOR  VISCUSO M J
TITLE  SHOT PRISCILLA, A TEST OF THE PLUMBBOB SERIES, 24 JUNE 1957

JRB-2-816-03-423-00          CNA-6001F                         810227      A U      0084     A103829      811256
ORG-AG JRB ASSOCIATES                                              AUTHOR  PONTON J
TITLE  SHOT GALILEC, A TEST CF THE PLUMBBOB SERIES, 2 SEPTEMBER 1957

JRB-2-816-03-423-00          CNA-6030F                         820802      A U      0078     A123423      830051
ORG-AG JRB ASSOCIATES                                              AUTHOR  MASSIE J
TITLE  SAFETY EXPERIMENTS, ACVEPEER 1955 - MARCH 1958

JRB-2-816-03-423-00          DNA-6006F                         810929      A U      0202     A118683      820682
CRG-AG JRB ASSOCIATES                                              AUTHOR  MAAG C
TITLE  SHOTS DIABLO TO FRAAKLIN PRIME, THE MID SERIES TESTS OF THE PLUMBBOB SERIES, 15 JULY - 30 AUGUST 1957
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        PRI-RPT                        SEC-RPT                     ORG-DT      H-CLASS     PG-LF      DDC-AD-NO      DTL-NO

JRB-2-816-03-423-00          DNA-6007F                             810930        A U        0146      A118680        820632
ORG-AG JRB ASSOCIATES                                                    AUTHOR  MASSIE J
TITLE  SHOTS WHEELER TO MORGAN, FINAL EIGHT TESTS OF THE PLUMBBOB SERIES, 6 SEPTEMBER - 7 OCTOBER 1957

JRB-2-816-03-423-00          DNA-6008F                             810928        A U        0144      A118681        820791
ORG-AG JRB ASSOCIATES                                                    AUTHOR  WEST J
TITLE  SHOTS BOLTZMANN TO WILSON, FIRST FOUR TESTS OF THE PLUMBBOB SERIES, 28 MAY - 18 JUNE 1957

NRDL-TR-1056                                                       660812          U        0060      639446         012922
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                    AUTHOR  JONES T H
TITLE  PREDICTION SYSTEM FOR THE NEUTRON INDUCED ACTIVITY CONTRIBUTION TO FALLOUT EXPOSURE RATES

NRDL-TR-321                                                        590403          U        0082      219720         012633
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                    AUTHOR  MILLER C F
TITLE  ANALYSIS OF RADIOLOGICAL DECONTAMINATION DATA OBTAINED FROM FIELD TESTS

NRDL-TR-331-EX                                                     810515        A U        0152      A995131        811651
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                    AUTHOR  DAY R P
TITLE  MEASUREMENT OF THERMAL RADIATION INCIDENT ON NAVAL AIRCRAFT IN FLIGHT AT OPERATIONS REDWING, PLUMBBOB AND HARDTACK, EXTR
       ACTED VERSION

NRDL-TR-344-REV                                                    590130          U        0016      239961         012649
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                    AUTHOR  MATHER R L
TITLE  CHANCE OBSERVATIONS OF FALLOUT CLOUD TRANSIT RADIATION AT OPERATION PLUMBBOB

NVO-1229-180                                                       710900          U        0081      A076360        112552
ORG-AG PHYSICAL DYNAMICS INC                                             AUTHOR  ESSINGTON E H
TITLE  DISTRIBUTION OF RADIOACTIVITY IN AND NEAR THE RAINIER RUBBLE CHIMNEY

OTO-57-2                                                           580715          U        0193      A077488        780369
ORG-AG REYNOLDS ELECTRICAL AND ENGINEERING CO                            AUTHOR
TITLE  PLUMBBOB ON-SITE RAD SAFETY REPORT
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        PRI-RPT                                SEC-RPT                ORG-DT      H-CLASS     PG-LF     DDC-AD-NO         DTL-NO

OTO-57-3                                                              570101          A U      0207      A075357           019932
ORG-AG REYNOLDS ELECTRICAL AAD ENGINEERING CO INC                          AUTHOR
TITLE  OPERATION PLUPBBCE CFF-SITE RADIOLOGICAL SAFETY REPORT

RRA-M42                        AFRRI-CR65-5                           651100          A U      0034      631747            791560
ORG-AG RADIATION RES ASSOCIATES                                            AUTHOR  FRENCH R L
TITLE  GAMMA RAY ENERGY ANC ANGULAR CISTRIBUTIONS NEAR THE AIR/    GROUND INTERFACE FROM PLANE FALLOUT AND POINT CO60 SCURCES

SAI-79-794-WA                  DNA-4747F                              790531          A U      0114      A070239           790653
ORG-AG SCIENCE APPLICATICAS INC                                            AUTHOR  GOETZ J L
TITLE  ANALYSIS OF RADIATICA EXPCSURE FOR TASK FCRCE WARRIOR, SHCT SMOKY, EXERCISE DESERT ROCK 7-8, OPERATION PLUMBBOB, FINAL
       REPORT FOR FEERUARY 1978 - FEBRUARY 1979

SAI-79-844-WA                  CNA-4772F                              800409          A U      0094      A085801           800751
ORG-AG SCIENCE APPLICATICAS INC                                            AUTHOR  GOETZ J
TITLE  ANALYSIS OF RADIATICA EXPOSURE FOR TASK FORCE BIG BANG, SHOTGALILEO, EXERCISE DESERT ROCK VII AND VIII OPERATION PLUMBBO
       B

SAI-82-504-WA                  DNA-5774F                              810615          A U      0080      A122204           821193
ORG-AG SCIENCE APPLICATICAS INC                                            AUTHOR  FRANK G
TITLE  ANALYSIS OF RADIATICA EXPCSURE, 4TH MARINE CORPS PROVISIONAL ATOMIC EXERCISE BRIGADE, EXERCISF DESERT ROCK 7, OPERATION
       PLUMBBOB, FINAL REPORT FOR 1 MARCH 1980 - 15 JUNE 1981

UCRL-5166-EX                                                          800201          A U      0096      A995021           801213
ORG-AG CALIFORNIA. UNIV., RACIATICN LAB                                    AUTHOR
TITLE  TEST DIRECTCRS REPCRT CN OPERATION PLUMBBCB, EXTRACTED VERSION

WT-1401                                                               620625            U      0202      344935            019739
ORG-AG BALLISTIC RES LABS. ARMY                                            AUTHOR  BRYANT E J
TITLE  BASIC AIRBLAST PHENCPENA /U/

WT-1403                                                               601215            U      0134      611257            019742
ORG-AG STANFCRD RES INST                                                   AUTHOR  SWIFT L M
TITLE  AIR-BLAST PHENCMENA IN THE HIGH-PRESSURE REGION, OPERATION PLUMBBOB, PROJECT 1.3


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      PRI-RPT                          SEC-RPT               ORG-DT      H-CLASS     PG-LF      DOC-AD-NO       DTL-NO

WT-1404                                                      600510        A U       0136       491310          019743
ORG-AG STANFORD RES INST                                        AUTHOR  SWIFT L M
TITLE  GROUND ACCELERATICA, STRESS,AND STRAIN AT HIGH INCIDENT OVERPRESSURES /U/

WT-1405                                                      600620        A U       0085       611229          019745
ORG-AG SANDIA LABS                                              AUTHOR  PERRET W R
TITLE  GROUND MOTICN STUDIES AT HIGH INCIDENT OVERPRESSURE

WT-1406                                                      600418          U       0108       356399          019747
ORG-AG ILLIAOIS. UNIV                                           AUTHOR  BULTMANN
TITLE  LOADING ON SIMULATED STRLCTURES AT HIGH IACIDENT OVERPRESSURES

WT-1407                                                      620705          U       0230       452637          019749
ORG-AG BALLISTIC RES LABS. ARMY                                 AUTHOR
TITLE  EFFECTS CF ROUGH AND SLCPING TERRAIN ON AIRBLAST PHENOMENA

WT-1408                                                      591109          U       0028       344937          019751
ORG-AG BALLISTIC RES LABS. ARMY                                 AUTHOR
TITLE  EFFECTS CF ROUGH TERRAIN CA DRAG SENSITIVE TARGETS

WT-1410-EX                                                   791001        A U       0112       A995006         801036
ORG-AG CEFENSE ATOMIC SUFPCRT AGENCY                            AUTHOR
TITLE  SOIL ACTIVATICN BY NEUTRCAS, PROJECT 2.1, OPERATION PLUMBBOB, EXTRACTED VERSION

WT-1411-EX                                                   800201        A U       0082       A995019         801121
ORG-AG CEFENSE ATCMIC SUFPCRT AGENCY, FIELD COMMAND             AUTHOR
TITLE  OPERATION PLUMBBOE, PROJECT 2.2, NEUTRON INDUCED ACTIVITIES IN SOIL ELEMENTS, EXTRACTED VERSION

WT-1412-EX                                                   791001        A U       0060       A995074         801557
ORG-AG DFFENSE ATOMIC SUPPORT AGENCY                            AUTHOR
TITLE  OPERATION PLUMBBCE, NEUTRCN FLUX FROM SELECTED NUCLEAR DEVICES, PRCJECT 2.3, EXTRACTED VERSION

WT-1413-EX                                                   800201        A U       0115       A995035         801496
ORG-AG CHEMICAL WARFARE LABS. ARMY                              AUTHOR
TITLE  OPFRATION PLUMBBCE, PROJFCT 2.4, NEUTRON AND INITIAL GAMMA SHIELDING, EXTRACTED VERSION
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WT-1414-EX
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY                            800201        A U       0134       A995036         801498
                                                                     AUTHOR
TITLE  OPERATION PLUMBBOB, PROJECT 2.5, INITIAL GAMMA RADIATION INTENSITY AND NEUTRON INDUCED GAMMAS RADIATION OF NTS SOIL, EXT
       RACTED VERSION

WT-1415-EX
ORG-AG SIGNAL CORPS ENGINEERING LABS. ARMY                      791001        A U       0071       B951766         800955
                                                                     AUTHOR
TITLE  OPERATION PLUMBBOB, PROJECT 2.6 EVALUATION OF NEW TYPES OF RADIAC INSTRUMENTS, EXTRACTED VERSION

WT-1416-EX
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY                            800901        A U       0097       A995057         801788
                                                                     AUTHOR  HANSCOME T D
TITLE  OPERATION PLUMBBOB, INVESTIGATION OF EFFECTS OF NUCLEAR DETONATIONS ON ELECTROMAGNETIC WAVE PROPAGATION AND NUCLEAR RADI
       ATION DETECTOR DESIGN, PROJECT 2.7, EXTRACTED VERSION

WT-1417
ORG-AG NEW YORK NAVAL SHIPYARD                                  591009        A U       0058       360872          019767
                                                                     AUTHOR  DIIANNI E J
TITLE  EVALUATION OF MILITARY RADIAC

WT-1418-EX
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY                            791001        A U       0016       B951740         800914
                                                                     AUTHOR
TITLE  OPERATION PLUMBBOB, NUCLEAR RADIATION RECEIVED BY AIRCREWS FIRING THE MB-1 ROCKET, PROJECT 2.9, EXTRACTED VERSION

WT-1419
ORG-AG SPECIAL WEAPONS CENTER. AF                               600223         U        0070       464381          019770
                                                                     AUTHOR  YORK E A
TITLE  INITIAL NEUTRON AND GAMMA AIR EARTH INTERFACE MEASUREMENTS

WT-1420
ORG-AG WATERWAYS EXPERIMENT STATION. ARMY                       590605         U        0144       B0010[illegible]5        019772
                                                                     AUTHOR  FLATHAU W J
TITLE  BLAST LOADING AND RESPONSE OF UNDERGROUND CONCRETE ARCH PROTECTIVE STRUCTURES

WT-1421
ORG-AG BUREAU OF YARDS AND DOCKS. NAVY                          600714         U        0070       6[illegible]406         019774
                                                                     AUTHOR  AMBRIGHT G H
TITLE  EVALUATION OF BURIED CONDUITS AS PERSONNEL SHELTERS

                                               UNCLASSIFIED
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RUN DATE: 05/02/83                            UNCLASSIFIED
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                                            PLUMBBOB        1957                                               PAGE:    11

          PRI-RPT                          SEC-RPT                   ORG-DT      H-CLASS      PG-LF       DDC-AD-NO       DTL-NO
WT-1422
ORG-AG BUREAU OF YARDS AND DOCKS. NAVY                               610228           U        0112        615737          019776
TITLE  EVALUATION OF BURIED CORRUGATED STEEL ARCH STRUCTURES AND ASSOCIATED COMPONENTS
                                                                          AUTHOR

WT-1423
ORG-AG ARMOUR RES FOUNDATION                                         600506           U        0132        460283          019777
TITLE  BLAST EFFECTS ON EXISTING UPSHOT KNOTHOLE AND TEAPOT STRUCTURES, PROJECT 3.4
                                                                          AUTHOR

WT-1424-1
ORG-AG STANFORD RES INST                                             620423           U        0068        491121          019779
TITLE  ISOLATION OF STRUCTURES FROM GROUND SHOCK (SUPERSEDES WT-1424, DATED 18 APRIL 1960)
                                                                          AUTHOR

WT-1425
ORG-AG AMERICAN MACHINE AND FOUNDRY CO                               600831          U         0168        355561          019781
TITLE  FULL SCALE FIELD TESTS OF DOME AND ARCH STRUCTURES                 AUTHOR  BULTMANN E H

WT-1426
ORG-AG BALLISTIC RESEARCH LABORATORIES                               600314         AU         0130        8951598         019783
TITLE  INSTRUMENTATION OF STRUCTURES FOR AIR BLAST AND GROUND SHOCKEFFECTS AUTHOR  MESZAROS J

WT-1427
ORG-AG WATERWAYS EXPERIMENT STATION. ARMY                            591023         A U        0174        460289          019786
TITLE  SOIL SURVEY AND BACKFILL CONTROL IN FRENCHMAN FLAT                 AUTHOR  GOODE T B

WT-1428
ORG-AG WALTER REED ARMY INST OF RES                                  610811         A U        0200        460308          019788
TITLE  EFFECTS OF NUCLEAR DETONATIONS ON A LARGE BIOLOGICAL SPECIMEN (SWINE) AUTHOR  MCDONNEL G M

WT-1429
ORG-AG WRIGHT AIR DEVELOPMENT DIV. AF                                600429         A U        0054        615738          019790
TITLE  EVALUATION OF EYE PROTECTION AFFORDED BY AN ELECTROMECHANICAL SHUTTER AUTHOR  GULLEY W E

WT-1430
ORG-AG BUREAU OF AERONAUTICS. NAVY                                   600725         A U        0089        360873          019792
TITLE  IN FLIGHT STRUCTURAL RESPONSE OF AN HSS-1 HELICOPTER TO A NUCLEAR DETONATION AUTHOR  WALLS J H

                                              UNCLASSIFIED
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       PRI-RPT                    SEC-RPT           ORG-DT     H-CLASS     PG-LF      DOC-AD-NO      DTL-NO
WT-1431
ORG-AG BUREAU OF AERCNALTICS. NAVY                  600425       A U       0078       360874         019794
                                                         AUTHOR  GILSTAD D A
TITLE  STRUCTURAL RESPONSE AND GAS DYNAMICS OF AN AIRSHIP EXPOSED TO A NUCLEAR DETCNATION

WT-1432
ORG-AG BUREAU OF AERCNALTICS. NAVY                  600210       A U       0190       360875         019796
                                                         AUTHOR  JULIAN A N
TITLE  IN FLIGHT STRUCTURAL RESPONSE OF FJ-4 AIRCRAFT TO NUCLEAR DETONATIONS

WT-1433
ORG-AG BUREAU OF AERCNALTICS. NAVY                  600331       A U       0186       355562         019798
                                                         AUTHOR  WALLS J H
TITLE  IN FLIGHT STRUCTURAL RESPCNSE OF THE MODEL A4D-1 AIRCRAFT TO A NUCLEAR EXPLCSION

WT-1434
ORG-AG WRIGHT AIR DEVELCPMENT DIV. AF               600322       A U       0056       357975         019800
                                                         AUTHOR  STALK G
TITLE  IN FLIGHT STRUCTURAL RESPONSE OF AN F-89D AIRCRAFT TO A NUCLEAR DETCNATION

WT-1435
ORG-AG MIDWEST RES INST                             600816       A U       0112       358121         019802
                                                         AUTHOR  DEEDS F E
TITLE  MINE FIELD CLEARANCE BY NUCLEAR WEAPONS

WT-1436-EX
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY, FC            800201       A U       0066       8951750        800960
                                                         AUTHOR  HAAS P H
TITLE  CPERATION PLUMBBCB, PROJECT 6.2, MEASUREMENT OF THE MAGNETIC COMPONENT OF THE ELECTROMAGNETIC FIELD NEAR A NUCLEAR DETON
       ATION, EXTRACTED VERSION

WT-1437
ORG-AG NAVAL AIR DEV CTR, AERO ELECTRCNIC AND ELEC LAB  600613    U       0060       311158         019806
                                                         AUTHOR  LEE W S
TITLE  ATTENUATION OF ELECTRCMAGNETIC RADIATION THROUGH AN IONIZED MEDIUM

WT-1440
ORG-AG QUARTERMASTER RES AND ENG COMMAND. ARMY      590610       A U       0048       460309         019811
                                                         AUTHOR  BABERS F H
TITLE  THERMAL PRCTECTICN CF THE INDIVIDUAL SOLDIER
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         PRI-RPT                          SEC-RPT              ORG-DT     H-CLASS      PG-LF      DDC-AD-NO       DTL-NO
WT-1441
ORG-AG NEW YORK NAVAL SHIPYARD                                600502        A U         0050       360876          019813
TITLE  PREDICTION OF THERMAL PROTECTION OF UNIFORMS, AND THERMAL EFFECTS ON A STANDARD REFERENCE MATERIAL
                                                                     AUTHOR  DERKSEN W L

WT-1443-EX
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY                          791001        A U         0224       A955020         801123
                                                                     AUTHOR
TITLE  OPERATION PLUMBBOB, INSTRUMENTATION FOR MEASURING EFFECTS PHENOMENA INSIDE THE FIREBALL, PROJECT 8.3B, EXTRACTED VERSION

WT-1444-EX
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY, FC                      791001        A U         0073       B951751         800961
TITLE  OPERATION PLUMBBOB OPERATIONAL SUMMARY, EXTRACTED VERSION     AUTHOR

WT-1445-EX
ORG-AG DEFENSE ATOMIC SUPPORT AGENCY                          791001        A U         0228       A995075         810001
                                                                     AUTHOR
TITLE  OPERATION PLUMBBOB, TECHNICAL SUMMARY OF MILITARY EFFECTS, PROGRAMS 1-9, EXTRACTED VERSION

WT-1452
ORG-AG BALLISTIC RES LABS. ARMY                               601018          U         0075       611230          019827
TITLE  INSTRUMENTATION OF STRUCTURES FOR AIRBLAST AND GROUND SHOCK EFFECTS
                                                                     AUTHOR  MEZZAROS J J

WT-1453
ORG-AG AMMANN AND WHITNEY                                     620619          U         0295       611259          019828
TITLE  TEST OF FRENCH UNDERGROUND PERSONNEL SHELTERS                 AUTHOR  COHEN E

WT-1454
ORG-AG AMMANN AND WHITNEY                                     620625          U         0258       691407          019829
TITLE  TEST OF GERMAN UNDERGROUND PERSONNEL SHELTERS                 AUTHOR  COHEN E

WT-1455
ORG-AG HOLMES AND NARVER INC                                  620515        A U         0164       611232          019830
                                                                     AUTHOR  CAMERON R A
TITLE  EVALUATION OF NUCLEAR BLAST EFFECTS ON AEC TEST SITE FACILITIES, PARTS 1, 2 AND 3

WT-1461
ORG-AG DEPARTMENT OF HEALTH EDUCATION AND WELFARE             580919          U         0014       611236          019834
TITLE  BLAST EFFECTS ON GLASS VACUUM CONTAINERS                      AUTHOR  LAUG E P
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        PRI-RPT                        SEC-RPT                 ORG-DT      H-CLASS     PG-LF       DDC-AD-NO        DTL-NO

WT-1462                                                        630612         U        0061        611231           019835
ORG-AG NEW YORK OPERATIONS, OFFICE HEALTH AND SAFETY LAB.         AUTHOR  BRESLIN A J
TITLE  PROTECTION AGAINST FALLOUT RADIATION IN A SIMPLE STRUCTURE

WT-1464                                                        590915         U        0160        611260           019837
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                             AUTHOR  STROPE W E
TITLE  EVALUATION OF COUNTERMEASURE SYSTEM COMPONENTS AND OPERATIONAL PROCEDURES

WT-1465-EX                                                     791001        A U       0112        A995003          801032
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                             AUTHOR  SCHUERT E A
TITLE  OPERATION PLUMBBOB, FALLOUT STUDIES AND ASSESSMENT OF RADIOLOGICAL PHENOMENA, PROJECT 32.4, EXTRACTED VERSION

WT-1466-EX                                                     810101        A U       0103        A995091          810734
ORG-AG EG AND G INC                                               AUTHOR  CORSBIE R L
TITLE  OPERATION PLUMBBOB, GAMMA DOSIMETRY BY FILM BADGE TECHNIQUES, PROJECT 39.1A, EXTRACTED VERSION

WT-1467                                                        590630         U        0068        A077511          019842
ORG-AG LOVELACE FOUNDATION FOR MEDICAL EDUC AND RES               AUTHOR
TITLE  BLAST BIOLOGY - A STUDY OF THE PRIMARY AND TERTIARY EFFECTS BLAST IN OPEN UNDERGROUND PROTECTIVE SHELTERS

WT-1468                                                        631028         U        0480        436391           019844
ORG-AG LOVELACE FOUNDATION FOR MEDICAL EDUC AND RES               AUTHOR  BOWEN I G
TITLE  SECONDARY MISSILES GENERATED BY NUCLEAR PRODUCED BLAST WAVES

WT-1470                                                        610123         U        0064        A077510          019848
ORG-AG LOVELACE FOUNDATION FOR MEDICAL EDUC AND RES               AUTHOR  GOLDIZEN V C
TITLE  MISSILE STUDIES WITH A BIOLOGICAL TARGET

WT-1471-EX                                                     791001        A U       0018        B951741          800913
ORG-AG OAK RIDGE NATL LAB                                         AUTHOR
TITLE  OPERATION PLUMBBOB, NEUTRON DOSIMETRY BY THE THRESHOLD DETECTOR TECHNIQUE, PROJECT 39.1B, EXTRACTED VERSION

WT-1477                                                        590400        A U       0028        611263           019860
ORG-AG FEDERAL CIVIL DEFENSE ADMINISTRATION                       AUTHOR  TITUS W F
TITLE  PENETRATION INTO CONCRETE OF GAMMA RADIATION FROM FALLOUT, REPORT TO THE TEST DIRECTOR, OPERATION PLUMBBOB
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       PRI-RPT                     SEC-RPT          ORG-DT     H-CLASS     PG-LF     DOC-AD-NO     DTL-NO
WT-1482
ORG-AG FEDERAL CIVIL DEFENSE ADMIN                  590909       A U        0032      611235        019863
TITLE  FIELD RADIOLOGICAL DEFENSE TECHNICAL OPERATIONS  AUTHOR  KILLIAN B C

WT-1485
ORG-AG OFFICE OF CIVIL DEFENSE                      620611        U         0026      607646        019865
TITLE  AERIAL MONITORING OPERATIONS DEVELOPMENT         AUTHOR  REHM F R

WT-1487
ORG-AG BALLISTIC MISSILE DIV. AF                    590817       A U        0040      491311        019867
TITLE  SPECTRA OF GROUND SHOCKS PRODUCED BY NUCLEAR DETONATIONS  AUTHOR  HALSEY J F

WT-1488
ORG-AG CALIFORNIA. UNIV, SCHOOL OF MEDICINE         660726        U         0276      A077509       019868
TITLE  DISTRIBUTION, CHARACTERISTICS, AND BIOTIC AVAILABILITY OF FALLOUT, OPERATION PLUMBBOB
                                                        AUTHOR  LARSON K H

WT-1489
ORG-AG DIAMOND ORDNANCE FUZE LABS                   601007       A U        0022      339501        019869
TITLE  EFFECT OF NUCLEAR RADIATION ON SEMICONDUCTOR DEVICES     AUTHOR  HAAS P

WT-1493
ORG-AG CALIF UNIV                                   610220       A U        0034      611249        019872
TITLE  CHEMICAL DOSIMETRY OF PROMPT AND RESUDUAL RADIATIONS FROM  NUCLEAR DETONATIONS
                                                        AUTHOR  TAPLIN GEORGE V

WT-1496
ORG-AG FEDERAL CIVIL DEFENSE ADM                    590501        U         0019      611237        019875
TITLE  EFFECT OF FALLOUT CONTAMINATION ON PROCESSED FOODS, CONTAINERS, AND PACKAGING
                                                        AUTHOR  LEININGER H V

WT-1497
ORG-AG DEPARTMENT OF HEALTH EDUCATION AND WELFARE   590501        U         0018      607647        019876
TITLE  EFFECT OF FALLOUT CONTAMINATION ON RAW AGRICULTURAL PRODUCTS
                                                        AUTHOR  LEININGER H V

WT-1498
ORG-AG DEPARTMENT OF HEALTH EDUCATION AND WELFARE   600628        U         0028      611238        019877
TITLE  MEASURING AND MONITORING TRAINING EXERCISE, FOODSTUFFS   AUTHOR  MCCONNELL H J
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       PRI-RPT                         SEC-RPT             ORG-DT      M-CLASS     PG-LF      DDC-AD-NO       DTL-NO

WT-1500                                                    600227         U        0066       339464          019880
ORG-AG SCHOOL OF AVIATION MEDICINE. AF                          AUTHOR  SIGOLOFF S C
TITLE  RADIATION MEASUREMENTS UTILIZING THE USAF CHEMICAL DOSIMETERS

WT-1501                                                    600401         U        0096       350279          019882
ORG-AG BALLISTIC RES LABS. ARMY                                 AUTHOR  MESZAROS J J
TITLE  BLAST MEASUREMENTS FOR CETG PROJECTS

WT-1504                                                    580919        A U       0147       B951581         019884
ORG-AG OAK RIDGE NATIONAL LAB                                   AUTHOR  HURST G S
TITLE  RADIATION DOSIMETRY FOR HUMAN EXPOSURES

WT-1505-EX                                                 791001        A U       0050       B951752         800957
ORG-AG SCHOOL OF AVIATION MEDICINE. AF                          AUTHOR
TITLE  OPERATION PLUMBBOB. BIOLOGICAL EFFECTS OF NUCLEAR RADIATION ON THE MONKEY (MACACA MULATTA), PROJECT 39.6, EXTRACTED VERS
       ION

WT-1507                                                    590900        A U       0025       611264          019888
ORG-AG LOVELACE FOUNDATION FOR MEDICAL EDUCATION AND RES        AUTHOR  RICHMOND D R
TITLE  INTERNAL ENVIRONMENT OF UNDERGROUND STRUCTURES SUBJECTED TO NUCLEAR BLAST, 2 - EFFECTS ON MICE LOCATED IN HEAVY CONCRETE
        SHELTERS, REPORT TO THE TEST DIRECTOR

WT-1508                                                    581001        A U       0061       B951725         019889
ORG-AG NAVAL MEDICAL SCHOOL                                     AUTHOR  IMRIE G W
TITLE  DEPTH DOSE STUDIES IN PHANTOMS WITH INITIAL BOMB AND NEUTRON RADIATION

WT-1509                                                    590501         U        0090       A077508         019890
ORG-AG ATOMIC ENERGY COMMISSION                                 AUTHOR  SIGLOFF S C
TITLE  REMOTE RADIOLOGICAL MONITORING

WT-1511                                                    610206         U        0070       A077507         019894
ORG-AG ROCHESTER. UNIV, ATOMIC ENERGY PROJECT                   AUTHOR  WILSON R H
TITLE  BIOMEDICAL AND AEROSOLS STUDIES ASSOCIATED WITH A FIELD RELEASE OF PLUTONIUM
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      PRI-RPT                 SEC-RPT            ORG-DT    H-CLASS    PG-LF     DOC-AD-NO    DTL-NO
WT-1512
ORG-AG SPECIAL WEAPONS CENTER. AF                610100       U       0063      810310       101070
                                                     AUTHOR  DICK J L
TITLE  MONITORING AND DECONTAMINATION TECHNIQUES FOR PLUTONIUM FALLOUT ON LARGE AREA SURFACES

WT-1513
ORG-AG SANDIA CORPORATION                        610800      A U      0039      611240       019898
                                                     AUTHOR  BUTLER R E
TITLE  SURFACE ALPHA MONITORING AS A METHOD OF MEASURING PLUTONIUM FALLOUT

WT-1517-EX
ORG-AG SANDIA CORP                               791001      A U      0079      B951753      800964
                                                     AUTHOR
TITLE  OPERATION PLUMBBOB, FIREBALL STUDIES, PROJECT 41.1A, EXTRACTED VERSION

WT-1519
ORG-AG SANDIA LABS                               641100      A U      0142      369966       019902
                                                     AUTHOR  DOLEN W K
TITLE  EFFECTS ON MATERIALS EXPOSED TO A NUCLEAR DETONATION, OPERATION PLUMBBOB

WT-1521-EX
ORG-AG SANDIA CORP                               791001      A U      0013      B951742      800915
                                                     AUTHOR  MEHL C R
TITLE  OPERATION PLUMBBOB, EFFECTS OF ALTITUDE ON NEUTRON MEASUREMENTS, PROJECT 41.3, EXTRACTED VERSION

WT-1522
ORG-AG SANDIA CORP                               000000      A U      0071      A995078      019905
                                                     AUTHOR  LAURSEN H G
TITLE  USE OF BALLOONS TO SUSPEND NUCLEAR TEST DEVICES, OPERATION PLUMBBOB

WT-1542
ORG-AG SCHOOL OF AVIATION MEDICINE. AF           600815       U       0051      611247       019921
                                                     AUTHOR  PICKERING J E
TITLE  BIOLOGICAL EFFECTS OF NUCLEAR RADIATION ON THE MONKEY (MACACA MULATTA), TWO YEAR EVALUATION
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KT-82-004-R              DNA-6039F                               820430        A U       0138        A122341          821305
ORG-AG KAMAN TEMPO                                                      AUTHOR  JONES C B
TITLE  OPERATICN ARGLS 1558

WT-1665-EX
ORG-AG DEFENSE ATCMIC SUPPORT AEENCY                             791001        A.U       0060        A995004          801039
TITLE  OPERATION ARGUS, REPCRT CF THE COMMANDER, TASK FORCE 88, EXTRACTED VERSION
                                                                        AUTHOR  MUSTIN L M

WT-1667
ORG-AG NAVAL ORDNANCE TEST STATION                               600525        A U       0042        360458           020071
TITLE  CPERATICN ARGUS, SATELLITE LAUNCHING FROM AIRCRAFT
                                                                        AUTHOR
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JTF-7                                                          571001        A U      0046      B951588       020146
ORG-AG JOINT TASK FORCE SEVEN                                       AUTHOR
TITLE  JOINT TASK FCRCE SEVEN OPERATION PLAN 1-58


JTF-7                                                          800201        A U      0212      A995002       801034
ORG-AG JOINT TASK FORCE 7                                           AUTHOR
TITLE  OPERATION HARCTACK, VCLUME 1 - RACIOLOGICAL SAFETY, FINAL REPORT


JTF-7                                                          791001        A U      0157      A085318       800845
ORG-AG JOINT TASK FCRCE 7                                           AUTHOR
TITLE  OPERATION HARCTACK, VCLUME 2 - RADIOLOGICAL SAFETY, FINAL REPORT, EXTRACTED VERSION


NRDL-TR-331-EX                                                 810515        A U      0152      A995131       811651
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                               AUTHOR  DAY R P
TITLE  MEASUREMENT OF THERMAL RADIATION INCIDENT ON NAVAL AIRCRAFT IN FLIGHT AT OPERATIONS REDWING, PLUMBBOB AND HARDTACK, EXTR
       ACTED VERSICN


OTO-58-3                                                       590400        A U      0037      A078823       008769
ORG-AG HOLMES AND NARVER INC                                        AUTHOR
TITLE  RADIOLOGICAL SAFETY SUPPCRT OPERATION HARDTACK, PHASE 1, TASK GROUP 7.5


TG-7.3                                                         580801        A U      0142      A078572       020140
ORG-AG JOINT TASK FORCE 7                                           AUTHOR
TITLE  OPERATION HARDTACK, MARCH-AUGUST 1958, FINAL REPORT




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NRDL-TR-331-EX
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                         810515         A U        0152       A995131         811651
TITLE  MEASUREMENT OF THERMAL RADIATION INCIDENT ON NAVAL AIRCRAFT AUTHOR  DAY R P
       ACTED VERSION                                IN FLIGHT AT OPERATIONS REDWING, PLUMBBOB AND HARDTACK, EXTR

OTO-58-6
ORG-AG REYNOLDS ELECTRIC AND ENGINEERING CO                   590801          U         0223       A076368         020145
TITLE  OPERATION HARDTACK-PHASE II OFF-SITE RADIOLOGICAL SAFETY REPORT, NEVADA TEST SITE, 1958
                                                                   AUTHOR  PLACAK C R

WB-LA-3
ORG-AG WEATHER BUREAU                                         600501         A U        0068       A078562         018453
TITLE  FALLOUT PATTERNS FROM OPERATION HARDTACK, PHASE 2           AUTHOR  TELEGADAS K
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       PRI-RPT                         SEC-RPT                  ORG-DT     H-CLASS     PG-LF      DOC-AD-NO      DTL-NO

WT-1817
ORG-AG LIVERMORE RADIATION LAB                                  640901        U         0013       633875         020204
TITLE  DISTRIBUTION OF THE RADIOACTIVITY FROM A NUCLEAR CRATERING EXPERIMENT    AUTHOR  MISKEL, J A
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                                                   SUNBEAM          1961

        PRI-RPT                         SEC-RPT              ORG-DT        H-CLASS      PG-LF       DDC-AD-NO        DTL-NO

FC                                                           810201          A U        0025        A995167          820785
ORG-AG CEFENSE ATCMIC SUPPORT AEENCY                                   AUTHOR
TITLE  LITTLE FELLER 1, TEST GROUP DIRECTORS CONCEPT, EXTRACTED VERSION

NRDL-TR-67-116                                               670702            U        0022        660655           103036
ORG-AG NAVAL RADICLCGICAL DEFENSE LAB                                  AUTHOR  PASCULA J N
TITLE  FRACTIONATICN VERSUS PARTICLE TYPE IN NUCLEAR SURFACE, SHCT SMALL BCY, DIFFERENCES IN RADIOCHEMICAL CCMPOSITION BETWEEN
       FRITTED AND SPHERICAL PARTICLES

NRDL-TR-67-88                                                670626          A U        0023        820147           102442
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                  AUTHOR  PASCUAL J N
TITLE  BIAS IN FALLOUT DATA FRCM NUCLEAR SURFACE SHOT SMALL BOY, AN EVALUATION OF SAMPLE PERTURBATION BY STEVE SIZING

NRDL-TR-67-90-EX                                             800201          A U        0036        B951703          800801
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                                  AUTHOR  KAWAHARA F K
TITLE  FALLOUT FROM NUCLEAR CRATERING SHOT DANNY BOY 1 -  RADIOCHEMICAL ANALYSIS AND SOME PHYSICAL OBSERVATIONS ON SELECTED SAM
       PLES, EXTRACTED VERSICN

WT-2209-EX                                                   810501          A U        0134        A995122          811480
ORG-AG HARRY DIAMCND LABS. ARMY                                        AUTHOR  CALDWELL P A
TITLE  OPERATION SUN BEAP, SHOT SPALL BOY, PROJECT OFFICERS REPORT, PROJECT 2.1, INITIAL RADIATION MEASUREMENTS, EXTRACTED VERS
       ION




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DOD
ORG-AG DEPARTMENT OF DEFENSE. OFFICE OF PUBLIC AFFAIRS             620000          A U        0075         A078541            781394
TITLE  DOMINIC, OBSERVER PROGRAM INFORMATION PACKET, 1962 TEST         AUTHOR
                                                                       SERIES

JTF-8
ORG-AG JOINT TASK FORCE 8                                          000000          A U        0030         406770             020167
TITLE  RADIOLOGICAL SAFETY - OPERATION DOMINIC                         AUTHOR  KNIPP A L

JTF-8
ORG-AG JOINT TASK FORCE 8                                          640604          A U        0078         A995161            009430
TITLE  ENCLOSURE N TO THE REPORT BY COMMANDER JOINT TASK FORCE EIGHT ON THE 1962 PACIFIC NUCLEAR TESTS, (OPERATION DOMINIC), RA
       DSAFE

NEL-1212-EX
ORG-AG NAVY ELECTRONICS LAB                                        810515          A U        0094         A995124            811482
TITLE  HYDROACOUSTIC SIGNALS AT LONG RANGES FROM SHOT SWORDFISH, EXTRACTED VERSION     AUTHOR  JOHNSON C T

NRDL-TR-867-EX
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                              810601          A U        0016         A995125            811481
TITLE  RADIOCHEMICAL DETERMINATION OF THE YIELD OF THE SWORD FISH DEVICE, EXTRACTED VERSION     AUTHOR  BUNNEY L B

POR-2004-EX
ORG-AG NAVAL RADIOLOGICAL DEFENSE LAB                              811101          A U        0044         A995152            820776
TITLE  OPERATION DOMINIC, SHOT SWORDFISH, PROJECT OFFICERS REPORT, PROJECT 2.1, RADIOLOGICAL EFFECTS FROM AN UNDERWATER NUCLEAR
        EXPLOSION, EXTRACTED VERSION                                   AUTHOR  JOHNSON L D

POR-2005-EX
ORG-AG DAVID TAYLOR MODEL BASIN                                    810515          A U        0093         A995139            820004
TITLE  OPERATION DOMINIC, SHOT SWORD FISH, PROJECT OFFICERS REPORT, PROJECT 3.1, SHOCK MOTIONS OF SHIPS AND EQUIPMENT, EXTRACTE
       D VERSION                                                       AUTHOR  ATCHISON C M
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PNE-225F                                                     620700         U         0114       A076366          100593
ORG-AG ATOMIC ENERGY CCPPISSION                                    AUTHOR
TITLE  CHARACTERISTICS CF FALLOUT  FROM A DFEPLY BURIFD NUCLEAR DETONATION FROM 7 1C TO MILES FROM  GROUND ZERO

PNE-228P                                                     630610         U         0045       A076365          014191
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PNE-200F                                                   630425       A U       0085      A076367         014177
ORG-AG PUBLIC HEALTH SERVICE                                     AUTHOR  PLACAK C R
TITLE  FINAL OFF SITE REPORT


PNE-205F                                                   620706       A U       0009      419534          014182
ORG-AG FEDERAL AVIATION AGENCY                                   AUTHOR  HALSEY J
TITLE  FEDERAL AVIATION AGENCY AIRSPACE CLOSURE


PNE-226F                                                   640303         U       0022      430806          014190
ORG-AG ATOMIC ENERGY COMMISSION                                  AUTHOR  ALLRED D M
TITLE  CLOSE IN EFFECTS OF AN UNDERGROUND NUCLEAR DETONATION ON SMALL MAMMALS AND SELECTED INVERTEBRATES


PNE-236F                                                   641113       A U       0058      A076363         014198
ORG-AG CALIFORNIA. UNIV, SCHOOL OF MEDICINE                      AUTHOR  MARTIN W E
TITLE  FOOD CHAIN RELATIONSHIPS OF IODINE-131 IN NEVADA FOLLOWING THE SEDAN TEST OF JULY 1962


PNE-237F                                                   650709         U       0065      A076364         014199
ORG-AG CALIFORNIA. UNIV, SCHOOL OF MEDICINE                      AUTHOR  MARTIN W E
TITLE  FOOD-CHAIN RELATIONSHIPS OF RADIOSTRONTIUM IN THE SEDAN FALLOUT FIELD
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Defense Nuclear Agency
Public Affairs Office
Washington, D. C. 20305
325-7095/7306

FACT SHEET

6 August 1980

HIROSHIMA AND NAGASAKI OCCUPATION FORCES

Introduction.

This Fact Sheet discusses the current Department of Defense (DoD) research effort into the postwar (1945-46) occupation of the Japanese cities of Hiroshima and Nagasaki by U.S. military forces. It outlines the circumstances and effects of the atomic bombing of those cities, the units involved in the occupation, their mission, the duration of their stay in Japan, the ionizing radiation exposure that individuals might have experienced as a result of residual radiation from the bombings, and the possible health risk that veterans of the occupation forces might experience as a result of those radiation doses.

DoD Research Program.

In 1977, as a result of growing national interest and concern over possible adverse health experiences of former servicemen who had participated in the atmospheric nuclear test program, 1946-62, DoD commenced an intensive, high-priority, multi-faceted program on behalf of these individuals. The program, termed the Nuclear Test Personnel Review (NTPR), involves detailed research into archives and data repositories nationwide; publication of a bookshelf of volumes comprising a personnel-oriented history of the atmospheric test program; declassification and reprinting of source documents; highly technical reconstruction of radiation dosages; wide-ranging public information programs aimed at establishing contact with former test participants; individual notification of participants who may have received radiation doses in excess of 5 rem, coupled with a program of free medical examinations; sponsorship of morbidity-mortality studies by the National Academy of Sciences to ascertain whether or not former test participants are experiencing adverse health effects that could be attributable to radiation exposure during the testing; and continuing assistance to veterans and the Veterans Administration (VA) on issues involving test participation, radiation exposure, and claims for VA compensation. The Defense Nuclear Agency (DNA) is the DoD executive agent for this NTPR program. It has been underway for over two years, and is estimated to require another two years for completion. It is adequately funded (about

$6 million per year) and is staffed at a level of about 170 man-years per year, including active NTPR teams in each Service. A separate DNA Fact Sheet on the NTPR program is available.

In 1979, when concerns arose that veterans of the postwar occupation of Hiroshima and Nagasaki might be experiencing adverse health effects, DNA expanded its on-going NTPR program to encompass these occupation veterans. Thus since the fall of 1979, DNA has been carrying out a detailed research program to recover, from records, historical documents, and interviews, all possible data pertaining to the possible radiation exposure of occupation troops. The Government is deeply concerned over the welfare of these veterans and is determined to ensure that the issue is fully investigated and that individual concerns receive rapid and thorough responses. This Fact Sheet summarizes our research to date.

The Wartime Bombings.

The bombings were carried out in early August, 1945. Their objective was to bring World War II to a quick end, and thereby avoid many months of fighting and continued destruction, and the deaths of an estimated million U.S. servicemen, an equal number of Allied servicemen, and a much larger number of Japanese, that would result from the planned invasion of the Japanese home islands. The targets in both Hiroshima and Nagasaki were military installations and war industries; and in both cases warnings and surrender ultimatums were given prior to the bombings. Several days after the bombings, the Japanese government indicated its willingness to surrender unconditionally, and the formal surrender took place on 2 September 1945, ending World War II.

The first atomic bomb was dropped on Hiroshima on 6 August 1945. It was a uranium-235 weapon, detonated about 1,670 feet above the ground, with a yield of about 13 kilotons (kt). Figure 1 is an outline map of Hiroshima, showing the built-up area of the city (shaded area), the hypocenter of the burst (the spot on the ground directly under the detonation), and the approximate perimeter of total destruction from blast and fire (dashed line). Figure 2 is a reproduction of a photograph illustrating the totality of devastation to Hiroshima inside this perimeter.

The second bomb was dropped on Nagasaki on 9 August 1945. It was a plutonium-239 weapon, detonated about 1,640 feet above the ground with a yield of about 23 kt. Figure 3 is an outline map of Nagasaki, showing the built-up area of the city (shaded area), the hypocenter of the burst (the spot on the ground directly under the detonation), and the approximate perimeter of total destruction from blast and fire (dashed line). Figure 4 is a reproduction of a photograph illustrating the totality of devastation to Nagasaki inside this perimeter.

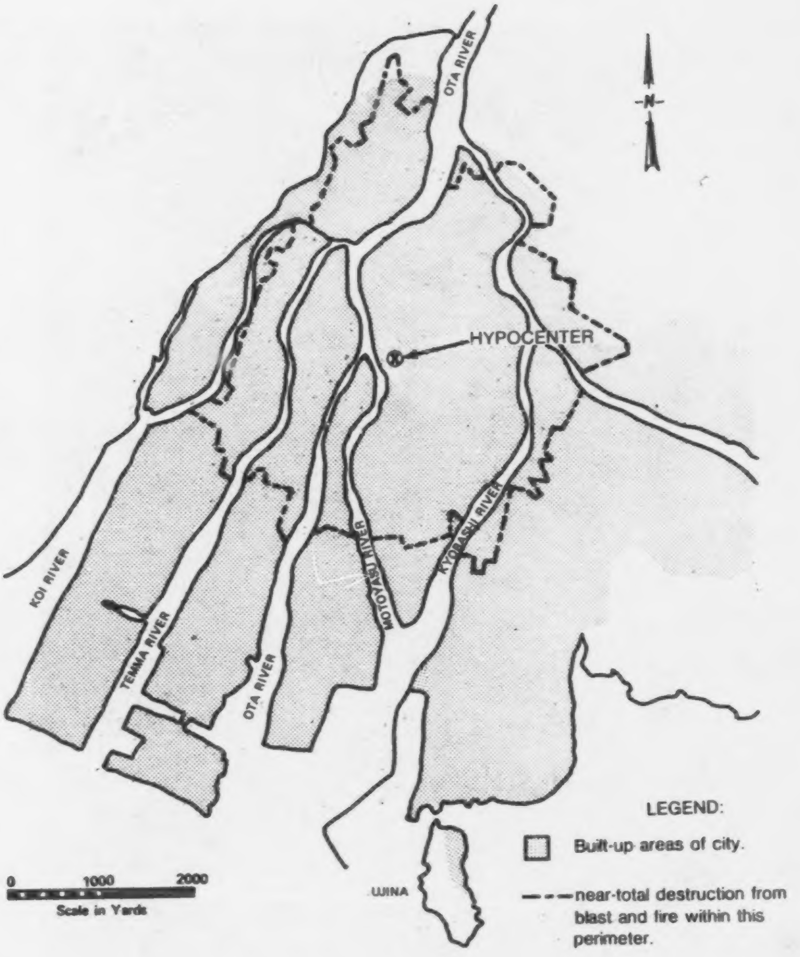
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Figure 1

HIROSHIMA

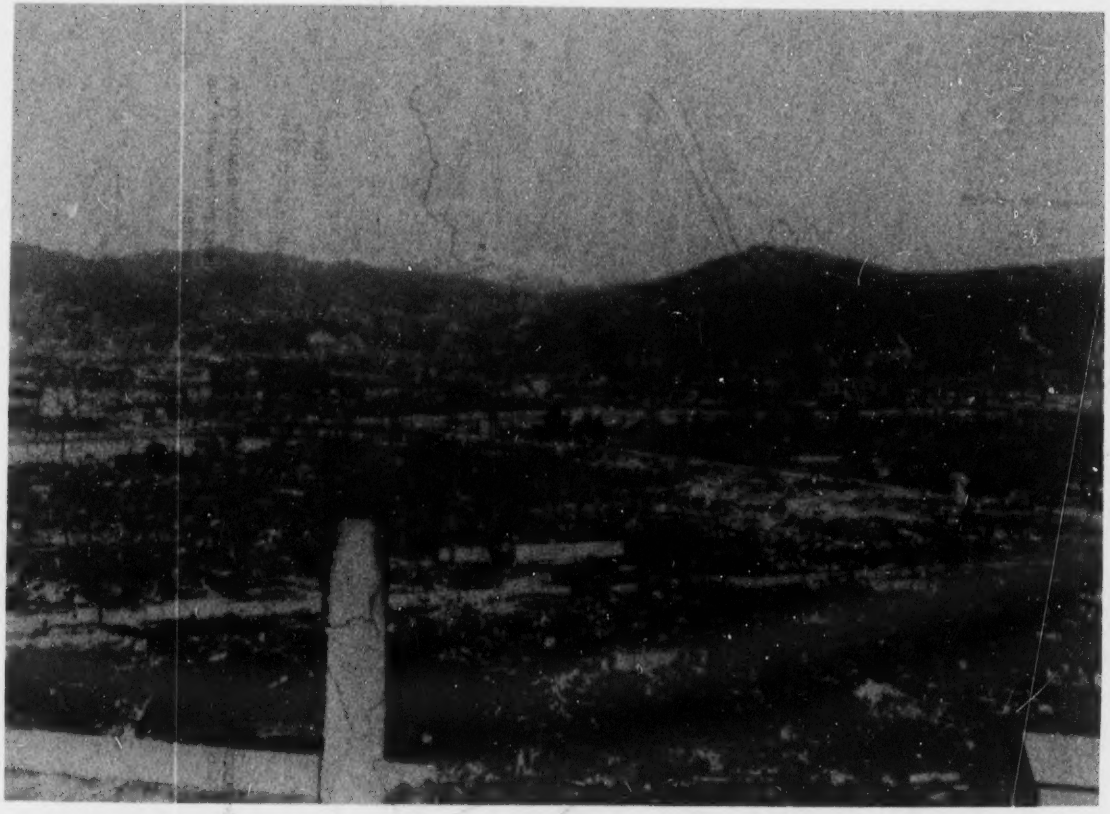
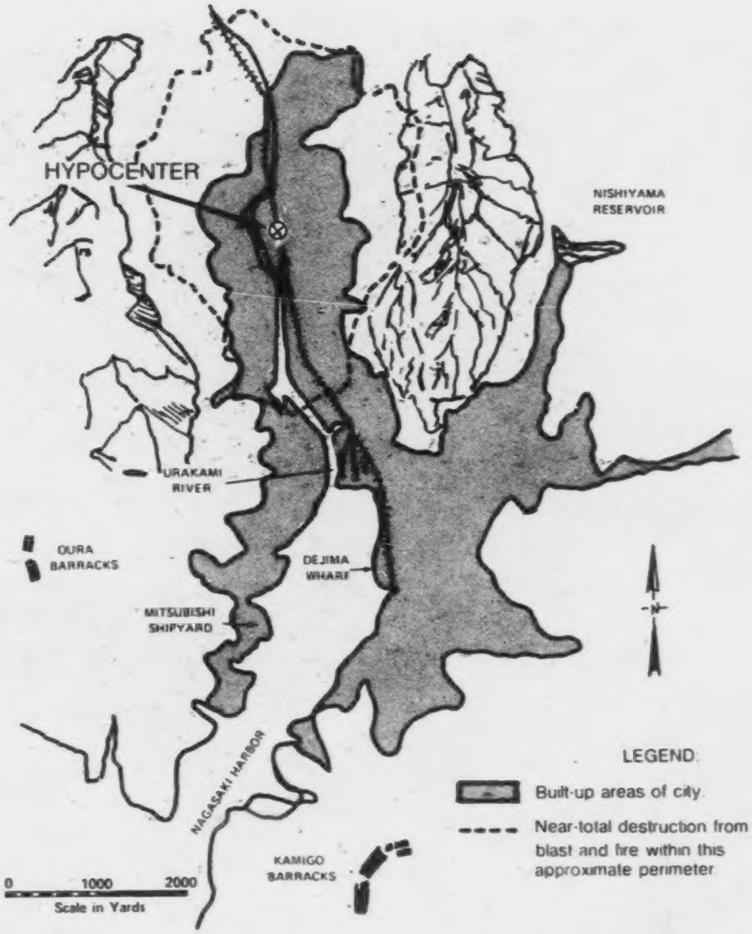


Figure 2. Hiroshima, looking across the Hypocenter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Built-up areas of city.
Near-total destruction from blast and fire within this approximate perimeter.
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Figure 3

NAGASAKI

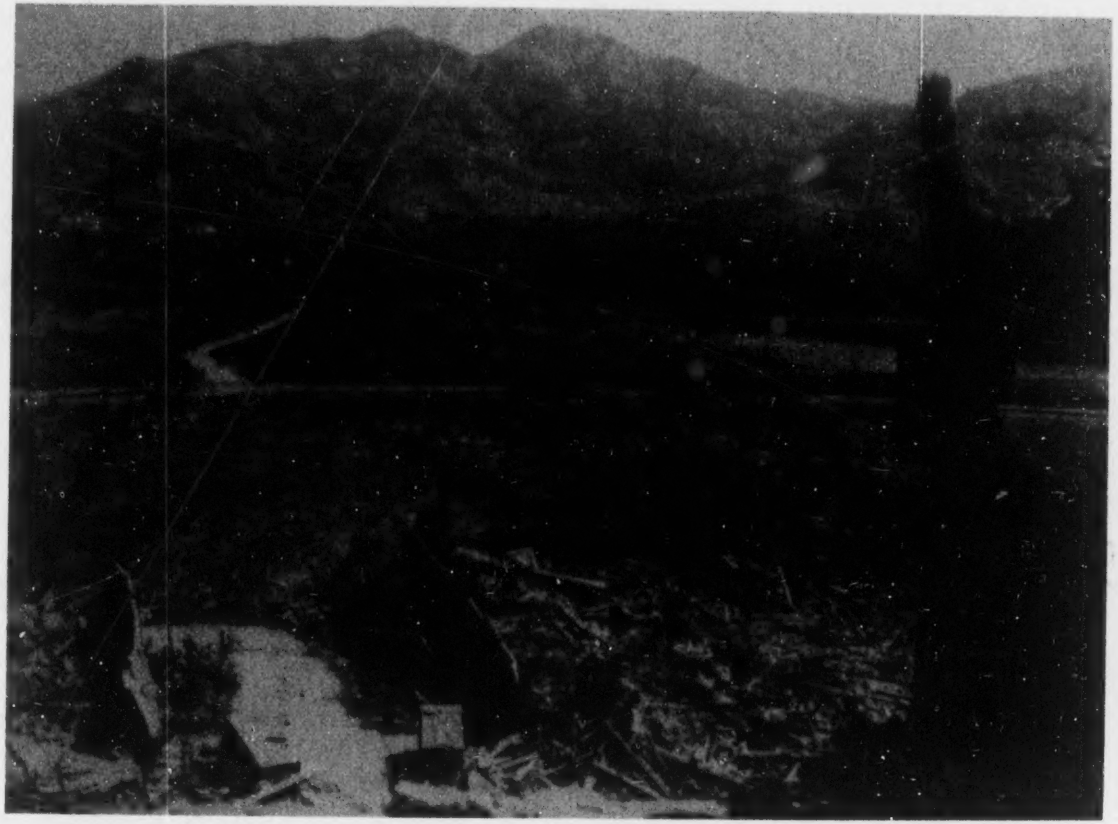

Figure 4. Nagasaki, looking across the Hypocenter

In terms of residual radiation, the effects in each city were similar. The burst altitude was so high that negligible residual radioactivity reached the ground in the vicinity of the hypocenter as local fallout. The detonation produced an instantaneous burst of gamma rays and neutrons and a fireball several hundred feet in diameter. Because the height of burst was 1600-1700 feet, the fireball's lower periphery was still a thousand feet or more above the ground at its maximum diameter. The fireball rose rapidly, at a rate of about 100 feet per second, accompanied by strong updrafts. On the ground, inrushing winds of high velocity entrained dust, converged on the burst point, and rose in a narrow column. These winds carried dust aloft, where it was mixed with the rising cloud of bomb residue. By the end of the first minute, the fireball had risen to a height of about one mile, had lost its brilliance, and was continuing to expand by mixing with the cooler surrounding air. The dust in the cloud became contaminated with the fission products and unfissioned material from the bomb as it continued to rise and mushroomed out at an altitude of several tens of thousands of feet. After some ten minutes the radioactive cloud reached its maximum height of 40,000-50,000 feet, all the while being blown downwind by the high-altitude winds. Initially, the radioactivity in this cloud was intense; however, as it was blown downwind over tens of thousands of miles it became quite dilute. Most of the radioactive particles eventually returned to earth over long periods of time as extremely low-level fallout covering much of the globe. However, at the local areas of the detonations themselves--that is, at the cities of Hiroshima and Nagasaki--the fission products, bomb residue, and contaminated dust were going up, not down.

Thus, in Hiroshima and Nagasaki, the high burst altitude was the key factor in preventing any significant residual contamination. Had either bomb burst on the surface, or at such a low altitude that the fireball reached the ground, it would have been a different story.

Early Radiation Surveys.

Immediately after the bombing a series of actions were undertaken to verify, through on-site surveys, that any residual radiation which might remain in the cities of Hiroshima and Nagasaki and their vicinity would not present a health hazard to occupation troops, or to continued habitation by the Japanese. The bombs had been planned as air bursts, thus it was anticipated that little residual contamination would remain in the vicinity after the detonations, and that whatever radiation there was would decay within days to very low levels. Scientific data taken at the time of the bombings showed that the detonations had occurred at the planned altitudes; however, U.S. authorities believed it essential to conduct radiation surveys of the cities themselves. An additional purpose of the surveys was the obtaining of scientific data on the effects of nuclear weapons.

- The first of these surveys was carried out on an urgent basis by scientists from the Manhattan District (the U.S. organization that had developed the bombs) under the leadership of General Farrell. With the forth-coming occupation by U.S. troops in mind, an August 12 message from General Marshall (U.S. Army Chief of Staff in Washington) to General MacArthur (the Theater Commander) emphasized the importance of getting the survey teams to the cities quickly ". . . in order that these troops shall not be subjected to any possible toxic effects, although we have no reason to believe that any such effects actually exist." The teams made rapid radiation surveys of Hiroshima on 8-9 September (a month before occupation troops arrived in that area), and of Nagasaki on 13-14 September (ten days before occupation troops arrived). They reported that there was negligible radioactivity. These "quick-look" reports served the critically important purpose of allowing occupation plans for these areas to proceed.

- A much more extensive survey was made a few days later by the Manhattan Project Atomic Bomb Investigating Group--some members of which had participated in the previous rapid surveys. This team of scientists made and recorded detailed measurements in Nagasaki from 20 September to 6 October, and in Hiroshima from 3 to 7 October, and filed extensive reports. These reports have been used over the subsequent years as basic source documents. All measurements showed the levels of residual radioactivity to be extremely low.

- A third series of on-site surveys was conducted a few days later by the Naval Technical Mission to Japan. This team surveyed Nagasaki during the period 15-27 October, and Hiroshima on 1-2 November 1945. The results of this extensive and well-documented survey corroborated the earlier conclusions that the residual radioactivity in and around Hiroshima and Nagasaki at the time the occupation forces arrived was so low as to present a negligible health hazard. These reports--like the previous ones--have been regarded over the years as basic source documents.

- These U.S. investigation teams also made use of data from numerous separate radiation monitoring surveys, soil and debris sampling programs, and other analyses conducted by Japanese scientists in the days and weeks immediately following the bombings. For example, from Tokyo Imperial University, Kyushu Imperial University, Kyoto Imperial University, Tokyo Institute of Physics and Chemistry, and other organizations, the following Japanese scientists were among those active in the initial surveys in 1945:

Takagi, Yamasaki, Sugimoto, Murati, Misonoo, Shinohara, Morita, Kohra, Masuda, Sakata, Nakane, Miyazaki. In some cases, copies of their reports were included in the above-mentioned U.S. reports. In other cases, they were published separately in Japan.

Some of the more extensive and pertinent of these early U.S. and Japanese reports are cited in the first section of "Selected References" at the end of this Fact Sheet.

Residual Radiation in Hiroshima and Nagasaki.

After the bombings there remained one area of low-level residual radioactivity in each city, and one area in the nearby vicinity of each city. The contamination in the cities themselves was caused by one mechanism, that outside the cities by another. The first type of residual radiation--which formed a roughly circular area around the hypocenter--was "induced radioactivity." The second type, which occurred downwind outside the city, was caused by "rainout" (a process similar to fallout). The following two sections describe each in turn.

Induced Radioactivity at the Hypocenters.

This pattern of residual radiation was created at the moment of detonation, when the high-intensity burst of neutrons from the bomb encountered atoms of normally non-radioactive elements in the soil and building materials (concrete, metal, tile, etc.) in the area beneath the detonation and caused them to become radioactive. Examples of elements in which radioactivity can be induced are aluminum, sodium, manganese, scandium, cobalt, and cesium. This induced radioactivity was of relatively low intensity, because of the relative scarcity of these elements. Furthermore, as in all radioactive materials, the intensity of radiation emitted continuously declined over time (that is, the elements became less radioactive). Many of these elements had short half-lives (the time required for the radiation intensity to be reduced from any given value to one-half that value). For example, aluminum-28 has a half-life of 2.3 minutes, sodium-24 has a half-life of about 15 hours, and manganese-56 has a half-life of about 2.6 hours. Because of these short half-lives, the decay in intensity of radiation in the relatively circular pattern of induced radioactivity around each hypocenter was relatively rapid.

Numerous experiments have been conducted over the years to verify the patterns of induced radioactivity measured at Hiroshima and Nagasaki. Nuclear weapons of comparable yield have been detonated at about the same altitudes at the Nevada Test Site, producing patterns of induced radioactivity quite similar to those measured in Hiroshima and Nagasaki. Likewise, Japanese roofing tiles, construction materials, and soil samples taken from Hiroshima and Nagasaki have been exposed experimentally to neutron bombardment similar to that produced by the wartime bombs, and the results have been compared to those measured in the bombed cities. Thus the mechanism of induced radiation is well understood.

In Hiroshima, when the first occupation troops arrived in the vicinity about 60 days after the bombing (see section below on Hiroshima occupation), the intensity of this induced radioactivity near the hypocenter had decayed to negligible levels. Figure 5 is a reproduction of the Hiroshima outline map shown in Figure 1, with a typical contour of induced radiation overlaid upon it. The pear-shaped outine of dots around the hypocenter on Figure 5 shows the iso-intensity contour of 0.03 milliroentgen per hour.*

Three points might be mentioned to put this low-level residual radiation in context. First, it covers a relatively small area of the city around the hypocenter. Second, it is centered in the area of maximum physical destruction from blast and fire. As can be seen from Figure 2, virtually nothing was left standing in the area where residual radiation existed. Third, the residual radiation intensity was extremely low-level. For example, if this contour of 0.03 milliroentgen per hour is taken as an average value of induced radioactivity in the vicinity of the hypocenter at the time of the troops' arrival, an individual working in this area for an eight-hour day would be exposed to 0.24 milliroentgen per day (0.03 x 8). Radioactive decay would reduce this exposure rate each subsequent day, but if this decay is disregarded for ease of calculation, in a month this individual would be exposed to approximately 7.2 milliroentgen (0.24 x 30). In a three-month period, which is a longer time than any U.S. military occupation unit remained in the vicinity of Hiroshima, the maximum total exposure of the individual working daily at the hypocenter would be about 22 milliroentgen (7.2 x 3). The dose received would be less than one two-hundredth of

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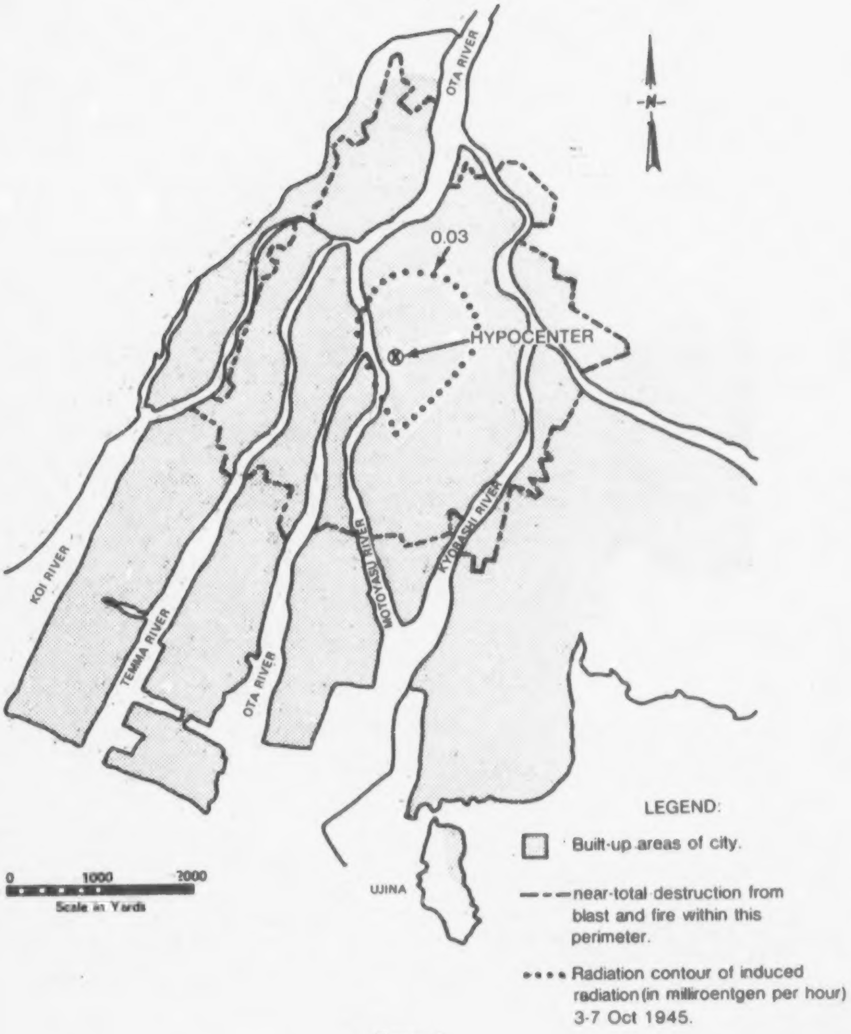
*Three units are commonly used in describing radiation levels. The Roentgen is a unit of exposure, a measure of radiation energy in air. (A milliroentgen--the unit used in this paper--is a much smaller measure, equal to one-thousandth of a Roentgen.) The rad is a unit of absorbed dose, a measure of radiation energy deposited in the body. The rem is a unit of dose equivalent, which adjusts the absorbed dose (in rads) for the relative effectiveness of the particular radiation. For example, exposure of an individual to one Roentgen of gamma radiation results in a dose of approximately 0.65 rem at the center of the body. Today's Federal guidelines allow radiation workers to receive a dose of 5 rem per year, more in some cases. A millirem, the measure of dose used in this paper, equals one-thousandth of a rem. Thus, under national (and most international) standards today, a radiation worker is permitted to accumulate a dose of 5,000 millirem per year.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▢ Built-up areas of city.
– – – near-total destruction from blast and fire within this perimeter.
• • • • Radiation contour of induced radiation (in milliroentgen per hour) 3-7 Oct 1945.

Figure 5

HIROSHIMA

today's allowable annual dose for radiation workers under Federal guidelines. It is also only a small fraction of the radiation dose each individual on earth receives annually from natural sources (cosmic and terrestrial radiation). For example, every resident of the U.S. receives a dose of about 100-400 millirem per year from naturally occurring radiation.

The maximum extent of the induced radiation at Hiroshima--that is, the circle of greatest diameter around the hypocenter at which any level of radioactivity above the natural background could be detected--was well inside the perimeter of near-total destruction shown by the dashed line on Figure 5. The highest intensity of radiation in the soil directly under the hypocenter at the time the occupation troops arrived in the vicinity was about 0.1 milliroentgen per hour. Thus, while there was residual radiation in Hiroshima, it covered a small area at the center of the physical devastation and its intensity--which was steadily declining--was so low as to be negligible.

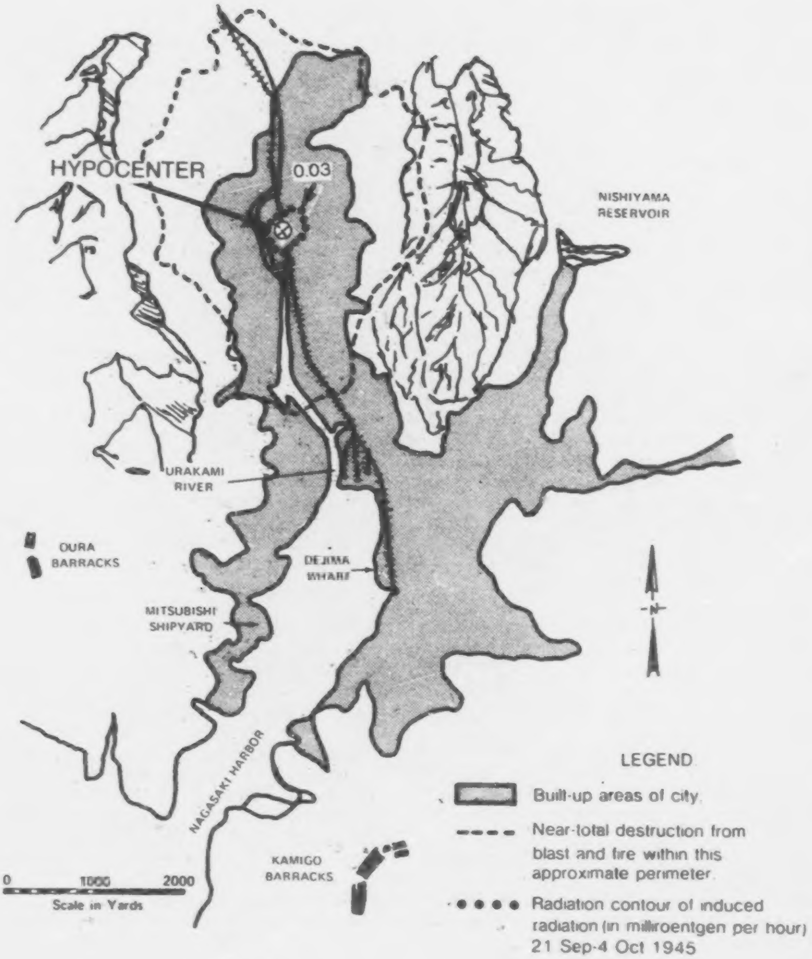
At Nagasaki, when the main body of occupation troops entered the city 45 days after the bombing (see section below on Nagasaki occupation), the residual radiation pattern from induced radioactivity around the hypocenter was as shown by the small pear-shaped outline of dots on Figure 6. As in the case of Hiroshima, virtually no residue from the bomb reached the ground in the vicinity of the hypocenter, and the low-level residual radioactivity that was measured by the numerous teams of Japanese and U.S. scientists was induced in normally non-radioactive substances by the intense burst of neutrons released at the instant of the bomb's detonation.

The area of induced radioactivity was somewhat smaller than that at Hiroshima. The contour shown is an iso-intensity line of 0.03 milliroentgen per hour. (Refer to the previous paragraph on induced radioactivity in Hiroshima for a discussion of the meaning and import of this very low level of radioactivity.)

The outermost perimeter of measurable induced radioactivity at Nagasaki was still well within the area of total destruction; and the "hottest" spot in the soil at the hypocenter itself had an intensity of less than 0.1 milliroentgen per hour. Thus, as in the case of Hiroshima, the only area that showed any radioactivity whatsoever at the time of arrival of the occupation troops was very small in size, was located at the center of the area of maximum destruction from blast and fire, where little or nothing was left standing (see Figure 4), was of such a low level as to be virtually negligible, and was decaying to a lesser intensity every day.

"Rainout" Radioactivity Downwind of the Cities.

In the vicinity of each city there was a second pattern of residual radioactivity produced by a different mechanism. As the radioactive cloud was borne downwind, rainshower activity within an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Built-up areas of city
Near-total destruction from blast and fire within this approximate perimeter
Radiation contour of induced radiation (in milliroentgen per hour) 21 Sep-4 Oct 1945

Figure 6

NAGASAKI

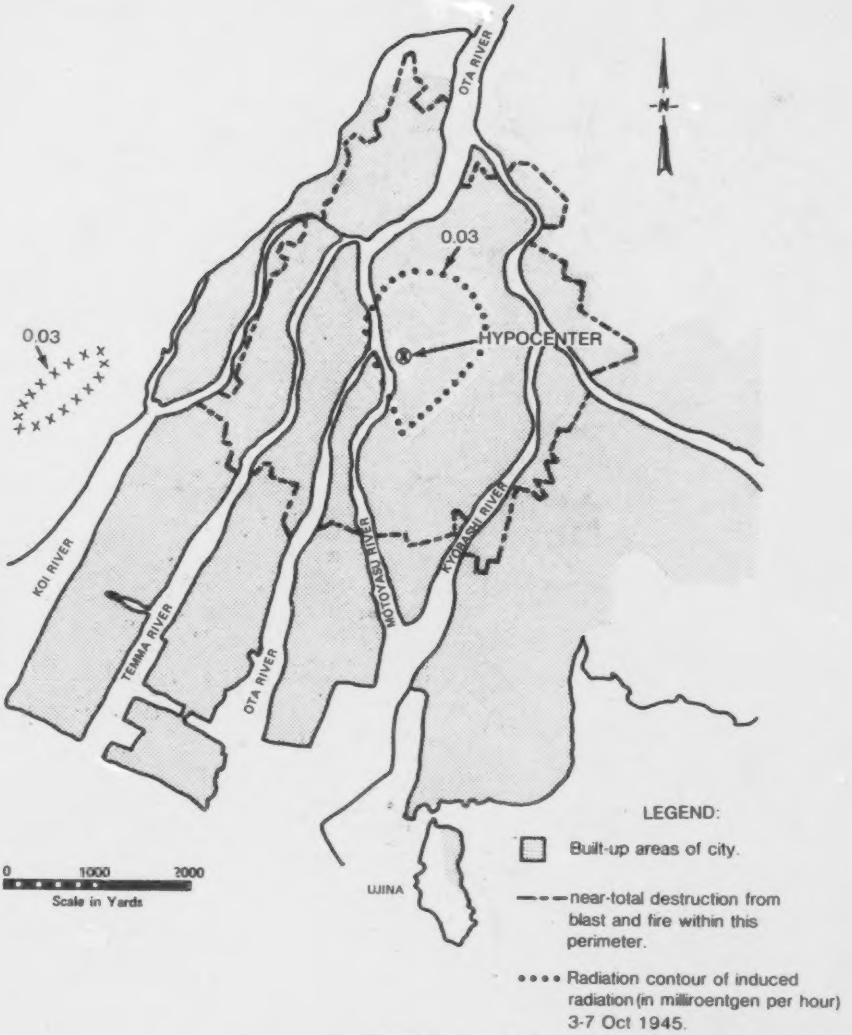
hour after the detonation caused fission products and unfissioned residue of the bomb to be carried to earth in a manner similar to fallout. This "rainout" produced a small pattern of radioactivity to the west of Hiroshima, near the village of Takasu; and a somewhat larger area to the east of Nagasaki, in the vicinity of the Nishiyama Reservoir.

The fission products and unfissioned residue of a nuclear weapon, when deposited on the ground, contain a mixture of hundreds of different radioisotopes, each decaying at its own rate according to its half-life. The overall decay rate of the entire mixture is very rapid. For several months after the detonation, this drop in radioactivity occurs at the rate of $T^{-1.2}$, where "T" is time in hours. As a rough rule-of-thumb, this means that if you start with a given intensity of radioactivity one hour after the detonation (H + 1), seven hours later the intensity of radiation would have dropped to one-tenth its former level. Two days after the detonation, the intensity of radiation would have decayed to about one-hundredth of its H + 1 value. Two weeks after the detonation the intensity of radioactivity in the fallout pattern would have dropped to one-thousandth of its H + 1 value. Thus, since the occupation troops arrived in the vicinity of Hiroshima more than eight weeks after the bombing, and in Nagasaki more than six weeks after that detonation, the intensity of the residual radiation in the Takasu area near Hiroshima and in the Nishiyama area near Nagasaki had dropped by a factor of many thousands from its intensity one hour after the bombings.

The small rainout pattern to the west of Hiroshima is shown in Figure 7 by an iso-intensity contour of 0.03 milliroentgen per hour (the oval of "x's"). At the time the occupation troops arrived in this part of Japan, the "hottest" spot in the center of this oval had an intensity less than 0.05 milliroentgen per hour.

The pattern of residual radioactivity caused by rainout near the Nishiyama Reservoir, east of Nagasaki, is shown in Figure 8. The area here is somewhat larger, and it has slightly greater intensity. The contour of "x's" shown is the approximate outline of the 0.1 milliroentgen per hour perimeter. Outside of this contour, the intensity falls to background levels very quickly in the reservoir area and in the direction of Nagasaki. Inside this contour, the intensity rises gradually to reach about one milliroentgen per hour at the "hottest" spot at the time of the troops' arrival.

Thus, of the four patterns of measurable residual radioactivity remaining in Japan at the time of arrival of the occupation troops, the most significant was in the vicinity of the Nishiyama Reservoir outside Nagasaki. It was also the only one of the four which included slight levels of plutonium in the radioactive mixture. This area, however, was remote and rugged, characterized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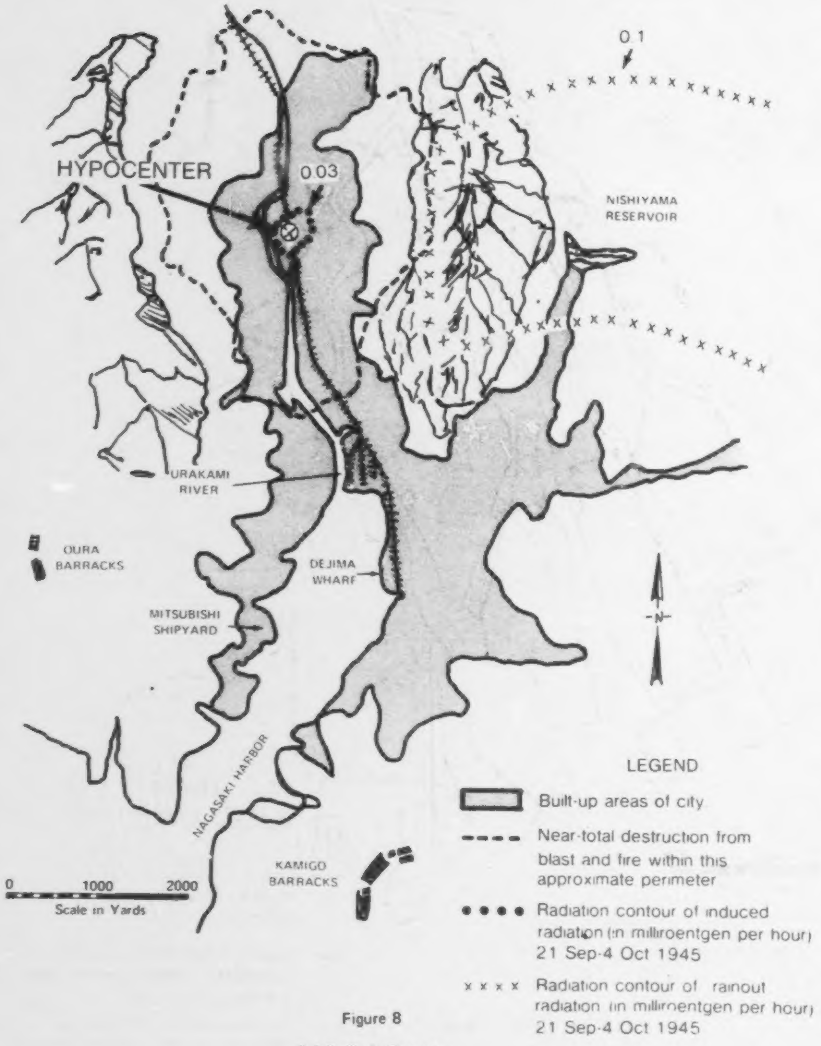
• • • • Radiation contour of induced radiation (in milliroentgen per hour) 3-7 Oct 1945.
x x x x Radiation contour of "rainout" radiation (in milliroentgen per hour) 3-7 Oct 1945

Figure 7

HIROSHIMA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Built-up areas of city
Near-total destruction from blast and fire within this approximate perimeter
Radiation contour of induced radiation (in milliroentgen per hour) 21 Sep-4 Oct 1945
Radiation contour of rainout radiation (in milliroentgen per hour) 21 Sep-4 Oct 1945

Figure 8

NAGASAKI

by steep slopes and heavy forests, with few trails or roads and even fewer buildings. Thus the Japanese population of the area was sparse, there were no occupation forces stationed in the vicinity, and there was little need for military patrols into the area.

One final comment should be made about the intensity of residual radioactivity--applying to the two patterns at Hiroshima and the two at Nagasaki. In addition to the rapid natural decline in radiation intensity through radioactive decay, the reduction in contamination was aided by the heavy rains that fell over southern Honshu and Kyushu that fall. In fact, Hiroshima experienced a severe typhoon in September 1945. Between the bombings and the time occupying troops arrived in the vicinity, approximately 62 centimeters (24 inches) of rain had fallen in Hiroshima, and 82 centimeters (32 inches) in Nagasaki. The heavy rainfall continued during the occupation, and by 1 November the cumulative total since the bombing had been 91 centimeters (36 inches) in Hiroshima and 122 centimeters (48 inches) in Nagasaki. This heavy rainfall washed away some of the residual radioactivity.

The Occupation of Japan.

As soon as the bombs were dropped and the Japanese gave indications of accepting the Allies' surrender terms, planning for the occupation of Japan was carried out intensively. The mission of the occupation troops was to establish control of the home islands of Japan, ensure compliance with the surrender terms, and demilitarize the Japanese war machine.

The mission did not include the "cleanup" of Hiroshima, Nagasaki, or any other areas, nor the rebuilding of Japan. These functions were carried out by the Japanese. In some cases, U.S. occupation forces had to repair a specific building for interim use, make an airfield operational, or clear a specific road for access; however, even in these cases, Japanese labor was generally used.

The occupation of the western portion of Honshu Island (which contains Hiroshima) and the southern Japanese islands of Kyushu (where Nagasaki is located) and Shikoku was the responsibility of the Sixth U.S. Army, which was composed of the I and X Army Corps and the V Amphibious Corps (Marines). Each Corps was made up of three divisions and supporting units. The occupation force for this portion of Japan totalled some 240,000 troops.

The basic organization chosen to accomplish the occupation mission was the infantry regiment, and the concept was to assign a regiment to each prefecture (similar to a U.S. county) within

Japan. The regimental commander was responsible for taking control of all Japanese military installations in his area, and for disposing of all weapons, ammunition, and military equipment (by destruction; by scrapping and returning to Japanese civil control; by shipping to the U.S. for training use, trophies, souvenirs; etc.). He was responsible for supervision of demobilization of the Japanese armed forces, for security of materiel throughout his assigned area, and for ensuring compliance with the surrender terms. In general, the mission was relatively easy to carry out because the Japanese were compliant and cooperative. Japanese military commanders were helpful and thorough in submitting lists of all installations and inventories of material, as well as in carrying out demobilization. Japanese police were effective in maintaining order among the Japanese and in providing laborers for heavy work.

The occupation situation in Hiroshima was quite different from that in Nagasaki, principally because the excellent harbor at Nagasaki had not been extensively mined and was immediately usable. Thus, Nagasaki became a primary staging area for insertion and withdrawal of occupation forces. This was not the case with Hiroshima, whose harbor had been heavily mined and thus was unusable for an extended period. Because of this, more occupation troops passed through Nagasaki, and more were stationed in its vicinity, than was the case for Hiroshima.

Another difference was that the occupation force at Hiroshima was composed primarily of Army troops, while that at Nagasaki was composed mostly of Marine Corps units, with small supporting Navy and Army elements.

As a general observation, it can be stated that throughout the occupation of Japan the troop situation changed continually. At the time of their initial assignments, units were virtually on a wartime footing. It quickly became apparent that this high troop density was not needed, because of the total cooperation of the Japanese. Additionally, pressures for demobilization of U.S. troops increased rapidly, and there was a desire to reduce troop commitments as rapidly as possible. "High point men"--those with longest service and thus most deserving of early discharge--were returned to the United States, and unit strengths were kept at adequate levels by reassignment of low point men between units. As entire units were deactivated or returned home, the area of responsibility of nearby units expanded rapidly. As some areas in Japan were stablized more rapidly than others, units were transferred from one assignment and location to another on short notice. The overall strength of the U.S. occupation forces dropped dramatically each month. Thus the duration of assignment of any individual or any unit in the occupation forces was quite short.

Hiroshima Occupation.

The occupation of western Honshu was assigned to the I and X Corps of the Sixth Army. Within the X Corps, responsibility for the prefectures in the vicinity of Hiroshima and Kure (about 11 miles southeast of Hiroshima) was initially assigned to the 41st Division. On 6 October 1945 units of the 41st Division landed at Hiro, about 15 miles southeast of Hiroshima, and secured the Kure Naval Yard. On 7 October the 186th Infantry Regiment of the 41st Division landed, and the Regiments's 2nd Battalion established headquarters and billets in Kaidaichi, about 5 miles southeast of the center of Hiroshima (well off the map in Figure 7). Since the city of Hiroshima had been almost totally destroyed by the bomb, no major units were stationed there throughout the occupation. One of the first actions the 186th Infantry Regiment carried out--on 7-8 October--was to set up a roadblock in the vicinity of Kaidaichi to prevent entry into Hiroshima by military personnel.

During the next two months, units of the 186th Infantry Regiment conducted reconnaissance patrols and other specific daily assignments throughout its area of responsibility, which included the city of Hiroshima. Thus it is reasonable to assume that individuals of the 186th Infantry Regiment made occasional patrols into the destroyed area of Hiroshima. Additionally, it seems reasonable to assume that individuals from any nearby units of the 41st Division who were able to obtain leave papers or passes might have made brief sightseeing trips there to view the destruction caused by the bomb. (On a typical patrol or sightseeing trip to the center of the bomb-devastated area, the maximum dose received should be less than 0.1 millirem.)

In December 1945 the 41st Division (including the 186th Infantry Regiment) was deactivated; and individuals were either returned to the United States for discharge or transferred to other units elsewhere in Japan.

Upon deactivation of the 41st Division the 24th Division took over their responsibilities in the vicinity of Hiroshima. The 34th Infantry Regiment of the 24th Division relieved the 186th Regiment of the 41st Division, and units of the 34th moved into the rehabilitated buildings, hotels, and private residences in Kaidaichi originally used by units of the 186th. The responsibilities of the 34th Regiment covered such a wide geographic area that eventually only one company--"G" Company of the 2nd Battalion--was stationed in the vicinity of Hiroshima. The Company was quartered in Ujina, a small island in the delta area just south of the city (see Figure 7).

On 6 March 1946 the 34th Regiment of the 24th Division was relieved by an Australian Infantry Battalion of the British Commonwealth Occupation Forces, and the U.S. occupation in the vicinity of Hiroshima came to an end.

Nagasaki Occupation.

The occupation of Nagasaki involved many more troops, and its history is much more extensively documented in Marine Corps records. Only those aspects pertaining to the issues at hand will be summarized here.

Prior to the actual occupation, two operations took place in Nagasaki during the period 11-13 September 1945. First, Nagasaki was used as a processing point for the repatriation of former prisoners-of-war who had been held in Japanese prison camps on the island of Kyushu. During this twelve-day period more than 9,000 Allied former POWs were moved through Nagasaki for evacuation to hospital ships awaiting in the harbor. A POW recovery team and a detachment of Marine guards were ashore in Nagasaki during this twelve-day period to accomplish this function. The harbor at Nagasaki was ideal for this purpose because of its location, its natural shelter, and its deep water. In spite of the devastation to the northern portion of the city, Nagasaki was feasible for use because the relatively great distance from the hypocenter to the waterfront (see Figure 8) caused the harbor area (docks, cranes, warehouses, buildings) to escape most of the destructive effects of the bomb and to be completely free from radioactivity.

Second, a small advance party of the occupation force (about 12 personnel) arrived in Nagasaki on 16 September and remained until the main force arrived on 23 September 1945.

The occupation of the Nagasaki area was assigned to the 2nd Marine Division, a unit of the V Amphibious Corps. The Division and its supporting units had a strength of about 20,000 personnel at the beginning of the occupation. The four principal combat units of the 2nd Marine Division were the 2nd, 6th, and 8th Regimental Combat Teams (RCTs) and an Artillery Group composed principally of the 10th Marine Regiment. The other units in the 2nd Marine Division were a Headquarters Battalion, Service Troops, an Engineer Group, a Tank Battalion, an Observation Squadron, and some smaller organizations.

Upon landing, the 8th RCT and the 10th Marine Regiment deployed immediately to Isahaya, some 10 miles north of Nagasaki. The 8th RCT had no involvement in the occupation of Nagasaki; and the 10th Marine Regiment did not return to Nagasaki until November.

The other elements of the 2nd Marine Division, numbering upwards of 10,000, debarked in the vicinity of the Dejima Wharf and the Mitsubishi shipyard (see Figure 8) and established command posts and billets in the vicinity. For example, the 2nd RCT landed on 23 September at Dejima Wharf, was billeted in the Kamigo barracks (see Figure 8), and established a command post at that location. The Team's zone of occupation included the east side of Nagasaki harbor and most of the nearby prefecture east of the Urakami River. The 6th RCT landed on 23 September in the Mitsubishi shipyard area, established a command post in that area, and was billeted in barracks at Oura (see Figure 8). The Team's zone of occupation included the west side of Nagasaki harbor and most of the nearby prefecture west of the Urakami River.

Over the next weeks and months there was a steady drawdown in the strength of the Division, as high point men were sent to the U.S. for discharge. There were also reassignments of areas of responsibility, as the 2nd Division took over areas that had previously been assigned to other units which departed. The 2nd RCT left Nagasaki in early November, and the 6th RCT departed in December 1945 along with two-thirds of the Engineer Group. The Headquarters Battalion and portions of the Service Troops left the Nagasaki area in January 1946. The Tank Battalion, which had landed and remained in Fukahori, about 9 miles southeast of Nagasaki, arrived in Nagasaki in November and departed in December 1945. The 10th Marine Regiment returned to Nagasaki from Isahaya in November 1945. This Regiment initially took over the responsibilities of the 2nd RCT, and soon the responsibilities of the 6th RCT as well.

The final units of the 2nd Marine Division--portions of the Service Troops, the last of the Engineer Group, and the 10th Marine Regiment--departed Nagasaki in June 1946, and the U.S. Marine Corps occupation of Nagasaki came to an end.

The strength of the 2nd Marine Division in Nagasaki is estimated to have remained above 10,000 for about the first three months of the occupation, through November 1945. For the next three months, through February 1946, Division strength in this area averaged about 5,000-7,000. For the last four months of the occupation, through June 1946, Division strength in Nagasaki was 3,000-4,000.

The specific billet locations of all units of the Division have not yet been precisely located, but without doubt they were in areas well clear of the hypocenter. Not only did the massive destruction of the blast and fire make that area uninhabitable (see Figure 4), but historical documentation shows that that area was avoided. For example, Volume V of the Marine Corps' "History of the U.S. Marine Corps Operations in World War II" states: "At 1300 on 23 September, the Second and Sixth Marines landed simultaneously on the east and west sides of the harbor. The two regiments moved out swiftly to occupy the city and curtain off the atom-bomb-devastated area."

Unquestionably there would have been occasions during the Nagasaki occupation on which patrols or other groups entered the areas of residual contamination to carry out specific missions. Also--as in the case of Hiroshima--it is reasonable to assume that individuals from units stationed nearby, who could obtain leave papers or passes, would have made brief sightseeing trips to the hypocenter to view the devastation caused by the bomb. (The maximum dose received on such a sightseeing trip should be less than 0.1 millirem.)

The U.S. Navy played a major role in transporting the Marines to Nagasaki and in evacuating POWs, but its role ashore was limited. During September 1945 some 136 Navy ships with about 34,000 crewmen arrived in Nagasaki harbor, generally docking at Dejima Wharf. Typical duration in port was three days, with cargo offload proceeding at maximum pace. Only a few ships, such as the hospital ship HAVEN (which was in port for 2-3 weeks), stayed longer. Ship traffic declined in subsequent months, with only 27 ships arriving in October.

Approximately 1100 Navy hospital corpsmen, a small number of medical and dental officers and chaplains, and an 800-man Construction Battalion, went ashore in Nagasaki assigned to 2nd Marine Division units. These Navy personnel left Nagasaki over the subsequent months--by reason of individual discharge or unit reassignment--at much the same rate as the Marines.

Atomic Bomb Casualty Commission.

Before proceeding to dose reconstructions, it is appropriate to discuss the remarkable research organization formed by Japanese and U.S. scientists shortly after the war and continuing to this day. In the previous section entitled "Early Radiation Surveys" it was mentioned that three U.S. and many Japanese teams of scientists made detailed, immediate surveys of the radiation environment and the effects of radiation upon the Japanese residents. These surveys commenced immediately after the bombings and continued for several months. Soon, a Japan-U.S. Joint Commission was organized, and detailed scientific investigations of the acute effects of the bombings were carried out. Based on the success of this early joint effort, President Truman in 1946 directed the National Research Council of the National Academy of Sciences to undertake a long-range study of the biological and medical effects of the atomic bomb on man. In response, the Academy organized "Atomic Bomb Casualty Commission (ABCC)" to continue this effort, commencing in 1947. The Japanese National Institute of Health (JNIH) began participation in the ABCC program in 1948, and it has continued to this date. In 1975, after 27 years of effective research, the Organization was re-established as the "Radiation Effects Research Foundation" (RERF), an incorporated foundation, managed and financed equally by the Governments of Japan and the U.S. The National Academy of Sciences continues directing RERF activities for the U.S.

The objectives of the ABCC/RERF are to conduct extensive, continuing, long-term studies into the effects of exposure to ionizing radiation in the survivors of the Hiroshima and Nagasaki bombings. To conduct this research, the ABCC/RERF maintains permanent research organizations in both Hiroshima and Nagasaki made up of medicine, clinical, pathology, radiology, statistics, and medical sociology departments. Over the past 32 years, the ABCC/RERF has published and distributed well over a thousand technical reports, and has made its findings even more widely available through publication in both English and Japanese versions of numerous medical and scientific journals.

The information thus published constitutes the most extensive and authoritative data available for the determination of radiation effects of the bombings, and of the overall risks of radiation-induced malignancy. Representative citations to this extensive body of scientific data are included under "Selected References" at the end of this Fact Sheet.

In summary, few world events have been as thoroughly documented at the time and as intensively and continuously studied by as many different groups of scientists as the atomic bombings and related radiation exposures at Hiroshima and Nagasaki. Thus--thanks to the ABCC/RERF--the patterns of residual radioactivity in Hiroshima and Nagasaki are well understood, and it is this large body of scientific material which is used by DNA and the Government in making current assessments of radiation-related issues.

Dose Reconstructions.

In order to be responsive to veterans, the VA, and others who are interested in the total dose received by veterans of the Hiroshima and Nagasaki occupation, DNA, with contractor support, has performed detailed dose reconstructions for the occupation forces. These dose reconstructions are based upon: (1) The patterns of residual radioactivity [illegible] were measured, documented, and published shortly after [illegible] bombings; (2) the extensive review and analysis of this residual radioactivity in the ensuing decades by the ABCC/RERF; and [illegible] the documented arrival and departure dates of each Army and Marine Corps [illegible] which operated in the vicinity of Hiroshima and Nagasaki.

These dose reconstructions take into account: (1) The external dose of gamma radiation which would have been received by anyone venturing into the four areas of residual contamination described in the earlier sections of this paper; (2) the possible internal dose of radiation that might have been received by anyone inhaling dust containing contaminated particles; and (3) the possible internal dose that might have been received by anyone drinking water containing dissolved or particulate radioactivity from the Nishiyama Reservoir.

Because we cannot track the exact movements of every individual for each day he was in Japan, it is necessary to base the dose reconstructions upon a "worst case" analysis. In this type of analysis, one makes assumptions about movements, assignments, living patterns, etc. which would maximize the dose received. Since the dose reconstructions involve quite a number of these assumptions, all of which employ not the "best estimate" but rather the extreme end of the range of probable actions, the result is not the dose that the individual with the highest exposure received, but rather a hypothetical extreme which in all probability no individual even approached.

Some typical assumptions used in making these "worst case" dose reconstructions are as follows:

- It is assumed that the individual was the first man of his unit to arrive in Hiroshima or Nagasaki and the last man to depart.

- It is assumed that the individual was assigned daily duties--seven days a week, from day of arrival to day of departure--at the "hottest" spot in the hypocenter or in the downwind "rainout" area.

- It is assumed that the individual worked a full eight-hour workday in that "hottest" area of the hypocenter (four hours per day for the "rainout" areas outside the built-up portion of the city, where there were no military activities of interest and patrol travel time was greater).

- For inhaled dose, it is assumed that aerodynamically resuspended particles had a size distribution that was optimum for inhalation and retention in the body.

- For inhaled dose, it is assumed that dust resuspension factors were those appropriate to desert areas.

- For ingested dose (Nagasaki), it is assumed that all fission products reaching the Nishiyama Reservoir were soluble.

- For ingested dose (Nagasaki), it is assumed that all drinking water for an individual during his tour in Japan came from the Nishiyama Reservoir.

Using these, and similar, "worst case" assumptions, the dose reconstructions show that *the maximum radiation dose any member of the U.S. occupation forces in Japan could have received--considering his external dose, his inhaled dose, and his ingested dose--was less than one rem.*

It should be reemphasized that these "worst case" dose reconstructions do not mean that any individual received close to one rem. Rather, the *highest* dose received by any individual in the occupation force was more likely in the tens of millirem; and the *average* dose received by individuals in the Hiroshima and Nagasaki occupation forces was probably very close to zero.

The reasons why no individual would have approached the upper end of the "worst case" dose reconstructions of "less than one rem" can be seen in the following observations about the assumptions for the dose reconstructions:

- Divisions, regiments, etc., were assigned responsibilities throughout the prefectures, areas many times larger than the area of the cities; however, the dose reconstructions assumed the individual was assigned to the cities themselves.

- Even within the cities, less than *one percent* of the built-up area of each city was contaminated at a dose rate greater than 0.1 milliroentgen per hour; however, the dose reconstructions assumed the individual spent his full workday every day within that one percent of the city's area.

- Related to the above assumption is the fact that there would have been no reason for a member of the occupation forces to be assigned duties at these "hot spots." Figures 2 and 4 suggest how pointless such an assignment would have been at the hypocenters; and there were no activities going on in the "rainout" areas that would have caused the assignment of an individual. However, the dose reconstructions assume the individual was at the "hot spots," regardless.

- Even should patrols have been ordered to these "hot spots" for specific tasks, there would have been no rationale for assigning full eight-hour (or four-hour) workdays in these areas; however, the dose reconstructions assume the full-time assignment.

- Specific patrol and guard assignments would undoubtedly have been rotated among unit members; however the dose reconstructions assume the same individual is assigned each day to the "hot spot."

- If contaminated particles were resuspended with dust, many particles would be too large (in micron diameter) for inhalation; however, the dose reconstructions do not reduce the inhaled dose for this factor.

- With one or two minor, brief exceptions, there is no indication of U.S. occupation forces being involved in, or in the vicinity of, significant dust-producing activity; however, the dose reconstructions assume that this occurred continuously.

- The torrential rains, and the resulting ever-present mud (which figures prominently in historical accounts), would have inhibited dust formation; however, the dose reconstructions assume desert conditions.

- A significant portion of any fission products which reached the Nishiyama Reservoir would have been insoluble, and thus would have been deposited in the reservoir sediment or trapped in the filtration process; however, the dose reconstructions do not reduce the ingested dose for this factor.

- The Marine troops at Nagasaki imported their drinking water from Saipan for the first three weeks; however, the dose reconstructions assume they drank local water from the time of their arrival until their departure.

- Five or six drinking water systems supplied Nagasaki (four or five reservoirs and one river system), and only one of these, the Nishiyama Reservoir, may have been slightly contaminated; however, the dose reconstruction assumes that all Nagasaki troops got all their drinking water from this contaminated reservoir.

In summary, after the most detailed research and meticulous dose reconstruction--using numerous assumptions which would maximize dose--no areas of concern or significant doubt can be identified, and the firm, well-substantiated conclusion is that the radiation doses received by members of the Hiroshima and Nagasaki occupation forces were negligible.

Health Effects of Radiation Exposure.

Over many decades, researchers of many nations have carried out extensive research into the health risks caused by ionizing radiation. This research has been so voluminous, detailed, and intensive that more is known about radiation and its health effects than about any other carcinogen. Numerous eminent scientific bodies, national and international, periodically review all known research and issue detailed scientific reports which summarize the current views of medical science on ionizing radiation injury.

Among these distinguished bodies are the International Commission on Radiological Protection (ICRP); the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR); the National Council on Radiation Protection and Measurements (NCRP); the National Academy of Sciences' Committee on the Biological Effects of Ionizing Radiation (BEIR); and the ABCC/RERF Foundation mentioned earlier.

These organizations--and the great majority of individual scientists--are in close agreement on the major aspects of the health effects of ionizing radiation. They differ to a small degree on some of the fine points. The consensus can be expressed as follows. It is known that exposure to high levels of ionizing radiation (e.g., 100 rem) causes adverse health effects. Although science does not have proof that exposure to low levels of ionizing radiation (e.g., a few rem) causes adverse health effects, it is assumed that this is so, and that the effects are proportional to the dose. The only type of adverse health effect believed to be caused by low-level exposures to ionizing radiation is a slight increase in the incidence of cancers that occur normally. This assumed increase is so small it has never yet been measured, thus there are slight disagreements as to its exact magnitude among the various distinguished scientific groups mentioned above.

A numerical example may serve to put this in context. This example is from the 1977 UNSCEAR report, however, it is quite similar to the numerical estimates of the other distinguished bodies. In any typical group of 10,000 Americans, our national cancer statistics tell us that about 1,600 will eventually die of cancer. These are "normal" cancer deaths, not caused by exposure to excess man-made ionizing radiation. This estimate of normal cancer deaths is so approximate that a variation by 50 or even 100 would not be regarded as abnormal. Thus a range of cancer deaths from about 1,500 to about 1,700 out of a typical group of 10,000 individuals would be regarded by medical science as being normal. Now, if each of the 10,000 individuals is exposed to one rem of man-made ionizing radiation, medical science assumes that statistically there will be one additional cancer death over the lifetimes of the 10,000 individuals. Thus if a variation in cancer deaths from about 1500 to 1700 is regarded as normal, and if the radiation exposure of each of the 10,000 individuals to one rem causes a statistical increase of only one death, it is easy to see why medical science has difficulty in identifying this effect with precision.

This numerical example also shows how minuscule is the health risk which members of the Hiroshima and Nagasaki occupation forces might face. Using Nagasaki as an example, more than 10,000 Marines were stationed in the vicinity and had the opportunity for some slight radiation exposure. The "worst case" exposure for any of these individuals is less than one rem. However, the average exposure (which is the important factor in health risk estimates), is in the very low millirem range. Thus in statistical terms, the expected number of cancer deaths from among the 10,000 individuals engaged in the Nagasaki occupation is possibly one-hundredth of one cancer death. At the same time, however, approximately 1,600 "normal" cancer deaths would be expected over the lifetimes of these 10,000 veterans. Thus the added risk from radiation exposure during the Japan occupation is so small as to be negligible--far less than many other risks which we all readily accept as a normal part of life.

One specific health risk deserves mention because it has received some recent publicity. This concerns a type of bone cancer known as "multiple myeloma." This is a fairly rare form of cancer which strikes late in life. Medical science believes multiple myeloma has a borderline relationship with exposure to ionizing radiation. That is, there are some indications that exposure to radiation may increase the risk of this disease, but science cannot yet be sure.

The recent concern has been based on the fact that four veterans of the Nagasaki occupation have been diagnosed as having multiple myeloma. This does not appear to represent an abnormal incidence of this disease. The following statistics from the National Cancer Institute are pertinent. If you start with 10,000 males, age 25, in 1945 (which approximates the Nagasaki Marines); then today, in 1980, about 7.7 deaths from multiple myeloma should have already occurred, based on normal statistics. In the next decade, the number of normal deaths from multiple myeloma from within this group can be expected to increase rapidly. By 1985 the total deaths should be about 12.5, and by 1990 about 19.3. Thus based on our research to date, the four multiple myeloma cases that are known are less than the number that would have been expected for a normal, non-radiation-exposed group of this age and size.

Strong support for this conclusion that Hiroshima-Nagasaki radiation exposures are not causing increased multiple myeloma comes from the extensive research of the ABCC/RERF. During the more than three decades since the bombings, researchers have maintained close follow-up on Japanese citizens who were in or near the cities at the time of the detonations. A 1979 ABCC/RERF technical report shows that of almost 33,000 Japanese who received a dose of one rem or less, no increase in multiple myeloma has occurred.

A final point might be made about health risk from radiation dose. Man has evolved through the ages in constant exposure to ionizing radiation. Cosmic radiation from the sun, and terrestrial radiation from naturally radioactive elements in the earth, bathe each of us continually, every day of our lives, in ionizing radiation. Our dose levels vary somewhat according to location. In the U.S., these range from a low of about 100 millirem per year (e.g., Louisiana) to a high of about 400 millirem per year (e.g., Colorado). The negligible health risk caused by radiation exposures at these low levels can be seen by the fact that researchers have never been able to detect any increased risk of cancer in locations where the annual radiation dose is four times greater (400 millirem rather than 100 millirem), in spite of having a vast data base.

Conclusions.

In summary, DNA's extensive research over the past ten months has disclosed no basis for concern by veterans of the Hiroshima and Nagasaki occupation force over an increased risk of adverse health effects.

The extensive radiation measurements and soil sample analyses taken by numerous Japanese and U.S. scientists in the weeks following the bombings are still available. These readings and subsequent radiation measurements and sampling, have formed the basis for intensive research over the past 35 years by Japanese and U.S. scientists of every aspect of the bombings and the radiation aftereffects. The Japanese and U.S. Governments--with the National Academy of Sciences managing the U.S. participation--have supported, stimulated, and advanced this research, until the radiation aspects of the bombings and the related health effects are one of the most thoroughly researched topics known to science.

Likewise, the history of the U.S. occupation of Japan is well documented in Army, Navy, and Marine Corps archives. It is known which units were present, when they arrived, where they were stationed, what their missions were, and when they departed.

From the above data, detailed technical dose reconstructions can determine the maximum possible radiation doses that might have been received by any individuals. Using all possible "worst case" assumptions, the maximum possible dose any individual serviceman might have received from external radiation, inhalation, and ingestion is less than one rem. This does not mean that any individual approached this exposure level. In fact, it is probable that the great majority of servicemen assigned to the Hiroshima and Nagasaki occupation forces received no radiation exposure whatsoever; and that the highest dose received by anyone was a few tens of millirem.

As regards health effects of this dose, all distinguished national and international groups of scientists whose views are regarded as authoritative in the field of ionizing radiation injury agree that the health risk from a dose such as this is negligible--so small statistically that it cannot be expressed in meaningful terms.

While these well-established facts appear quite conclusive, nevertheless DNA is continuing its research into all aspects of the Hiroshima-Nagasaki occupation.

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Regulations: that the Editorial Note at the end of § 1308.32 be deleted; and that § 1308.32 be revised to read as follows: (Sec. 202(d), 301, 501(a), Controlled Substances Act, 21 U.S.C. 812(d), 821, 871(a), 28 CFR 0.100, 47 FR 43370–1).

§ 1308.32 Excepted compounds.

Until criteria are adopted by the Administration by which the Acting Administrator may determine whether to except any compound, mixture or preparation containing any depressant or stimulant substance listed in §§ 1308.12(e), or in 1308.13 (b) or (c), or in 1308.14 or in 1308.15 from the application of all or any part of the Act (21 U.S.C. 812(d)), the drugs listed in the Table of Excepted Prescription Drugs set forth below have been excepted by the Administrator from the application of sections 302 through 305, 307 through 309, 1002 through 1004 of the Act (21 U.S.C. 822, 823, 825, 827–8, 952–4) and §§ 1301.11, 1301.12, 1301.21 through 1301.24, 1301.31, 1301.32, and 1301.71 through 1301.76 of this chapter for administrative purposes only. The exception of these drugs by the Administrator should not be construed as an adoption or rejection of the criteria by which these drugs were originally excepted. Any deviation from the quantitative composition of any of the listed drugs shall require a petition for exception in order for that drug to be excepted.

Dated: March 7, 1983.

Gene R. Haislip,

Deputy Assistant Administrator, Office of Diversion Control, Drug Enforcement Administration.

[FR Doc. 83-[illegible] Filed 3-11-83; 8:45 am]

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DEPARTMENT OF THE TREASURY

Internal Revenue Service

26 CFR Part 1

[T.D. 7869]

Income Tax; Taxable Years Beginning After December 31, 1953; Deep Discount Industrial Development Bonds

Correction

In FR Doc. 83–1124 beginning on page 1708 in the issue of Friday, January 14, 1983, make the following corrections:

On page 1709, in the table, in the second column, the purchase price for "Aug. 1, 1984" should read $20,490,403.66"; and in the third column, the interest for "Aug. 1, 1986" should read $2,479,338.64".

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26 CFR Part 51

[T.D. 7871]

Excise Tax Regulations Under the Crude Oil Windfall Profit Tax Act of 1980; Exempt Royalty Oil

Correction

In FR Doc. 83–1127 beginning on page 1711, in the issue of Friday, January 14, 1983, make the following corrections:

1. On page 1711, second column, second full paragraph, fifteenth line from the bottom, remove the second phrase "owner also".

2. On page 1712, first column, the section number now reading "§ 51–4995–2" should read "§ 51.4995–2"; third column, the authority citation should read as set forth below:

"(This Treasury decision is issued under the authority contained in sections 4995 and 7805 of the Internal Revenue Code of 1954 (95 Stat. 337 and 68A Stat. 917; 26 U.S.C. 4995 and 7805).)"

BILLING CODE [illegible]

EQUAL EMPLOYMENT OPPORTUNITY COMMISSION

29 CFR Part 1601

706 Agencies; Handling of Employment Discrimination Charges

AGENCY: Equal Employment Opportunity Commission.

ACTION: Final rule.

SUMMARY: The Equal Employment Opportunity Commission amends its regulations designating certain State and local fair employment practices agencies (706 Agencies) so that they may handle employment discrimination charges, within their jurisdictions filed with the Commission. Publication of this amendment effectuates the designation of the City of Salina (Kansas) Human Relations Commission and Department as a 706 Agency.

EFFECTIVE DATE: March 14, 1983.

FOR FURTHER INFORMATION CONTACT: Hollis Larkins, Equal Employment Opportunity Commission, Office of Program Operations, Special Services Staff, 2401 E Street, NW., Washington, D.C. 20506, telephone 202/634–6850.

SUPPLEMENTARY INFORMATION:

List of Subjects in 29 CFR Part 1601

Administrative practice and procedure, Equal employment opportunity, Intergovernmental relations.

PART 1601—PROCEDURAL REGULATIONS

In Title 29, Chapter XIV of the Code of Federal Regulations, § 1601.74(a) is amended by adding in alphabetical order the following agency:

§ 1601.74 Designated and notice agencies.

(a) * * * City of Salina (Kansas) Human Relations Commission and Department

* * * * *

(Sec. 713(a) 78 Stat. 265 (42 U.S.C. 2000e-12(a))

Signed at Washington, D.C. this 8th day of March, 1983.

For the Commission.

John D. Schmelzer,

Legal Advisor.

[FR Doc. [illegible] Filed 3-11-83; 8:45 am]

BILLING CODE [illegible]

DEPARTMENT OF DEFENSE

Defense Nuclear Agency

32 CFR Part 218

Guidance for the Determination and Reporting of Nuclear Radiation Dose For DOD Participants in the Atmospheric Nuclear Test Program (1945–1962)

AGENCY: Defense Nuclear Agency, DOD.

ACTION: Final rule.

SUMMARY: This rule establishes guidance to DoD Components for the determination and reporting of ionizing radiation dose for DoD participants in the atmospheric nuclear test program (1945 to 1962). This rule is being published to establish scientific principles on this methodology, and its intended affect is to standardize the methodology used in the dose reconstruction effort of the nuclear test personnel review program.

EFFECTIVE DATE: This rule will be effective March 14, 1983.

FOR FURTHER INFORMATION CONTACT: Mr. Robert L. Brittigan, Defense Nuclear Agency, ATTN: GC, Washington, D.C. 20305 (Telephone 202–325–7681).

SUPPLEMENTARY INFORMATION: On May 20, 1982, the Defense Nuclear Agency (DNA) published and solicited public comments upon a "Request for Comments on Proposed Guidance" (47 FR 21853). Five comments were received: two from individuals and three from organizations. Based upon the comments, the proposed guidance was amended as indicated below and is now being published as a final rule.

Legal Authority

On March 25, 1982, the United States District Court for the District of Columbia filed a Memorandum Order in the case of *Gott v. Nimmo*, Civil Action No. 80–906. The order requires the Defense Nuclear Agency to promulgate "rules which establish methodologies and standards to calculate radiation exposure." A notice of appeal has been duly filed and, in the event the decision of the District Court is reversed, this rule will be withdrawn.

Discussion of Comments

One organization commented that inadequate data is available to permit any meaningful dose reconstruction and that the Defense Nuclear Agency, because of institutional bias, should not be permitted to engage in dose reconstruction. We believe that adequate data is available regarding film badge records, the radiological environments, activities of participants, internal exposure hazards, and all other factors in the methodology. We also believe that DNA's national security responsibilities do not preclude the Agency from conducting unbiased research. Moreover, promulgation of this rule is required under the Order in *Gott v. Nimmo*, an Order which the commenting organization, representing the plaintiffs, expressly sought and obtained.

Several comments recommended that dose reconstruction methodologies applicable to veterans of the Hiroshima/Nagasaki occupation be included. Although the detonations at Hiroshima and Nagasaki were not tests, American servicemen were involved and their doses were reconstructed using the methodology in this rule ("Radiation Dose Reconstruction, U.S. Occupation Forces in Hiroshima and Nagasaki, Japan, 1945–1946," DNA Report 5512F, Aug. 1980).

One comment addressed the time required for the review and declassification or sanitization of documents. Declassification of documents is outside the scope of this rule. However, substantial declassification has already taken place.

One organization expressed concern that Department of Defense personnel may have participated in unannounced nuclear tests. We know of no unannounced tests involving DoD personnel in the period covered by this rule.

Several comments urged DNA to consider the current health experience of the veterans in determining dose estimates. There are no scientific means to determine a radiation dose based upon the health of an individual some twenty to thirty-five years after exposure.

A comment was received that indicated that DNA methods do not adequately include radiation exposure from radioactive material inhaled or ingested by test participants. Research indicates that the greatest radiation hazard to the majority of test participants was from external gamma radiation. However, where analysis suggests a meaningful contribution from internal dose, its reconstruction is clearly included by the rule.

The methodologies set forth in this rule are based on established scientific principles and reflect our best judgement as to the proper approach. Reports using the methodology have been widely distributed and reviewed. We have received no comments that suggest that the methodology is unsound. Furthermore, the National Academy of Sciences has examined case histories employing the methodology and has not recommended changes thereto. Moreover, each participant can obtain, upon request, detailed information regarding the procedures used to determine his dose and can subject that methodology to independent review.

Regulatory Impact Analysis

Under E.O. 12291, the Department of Defense must determine if a regulation is "major" and therefore subject to a Regulatory Impact Analysis. Because the Department of Defense believes that this amendment is not "major"; it is not subject to such an analysis.

Regulatory Flexibility Act

In accordance with 5 U.S.C. 605(b), as added by the Regulatory Flexibility Act, the Department of Defense certifies that this rule will not have a significant economic impact on a substantial number of small entities.

Paper Work Reduction Act

This rule does not impose any additional reporting or recordkeeping requirements requiring Office of Management and Budget clearance.

List of Subjects in 32 CFR Part 218

Radiation dose determination, Dose reconstruction, Dose reconstruction methodology, Radiation environment.

M. S. Healy,

OSD, Federal Register Liaison Officer, Department of Defense.

Accordingly, Title 32, Chapter 1 is amended by adding a new Part 218, reading as follows:

PART 218—GUIDANCE FOR THE DETERMINATION AND REPORTING OF NUCLEAR RADIATION DOSE FOR DOD PARTICIPANTS IN THE ATMOSPHERIC NUCLEAR TEST PROGRAM (1945–1962)

Sec.
218.1 Policies.
218.2 General procedures.
218.3 Dose reconstruction methodology.

Authority: U.S. District Court of the District of Columbia, Civil Action No. 80–906.

§218.1 Policies.

(a) The basic means by which to measure dose from exposure to ionizing radiation is the film badge. Of the estimated 220,000 Department of Defense participants in atmospheric nuclear weapons tests, about 145,000 have film badge dose data available. The information contained in the records has been reproduced in a standard format and is being provided to each military service, which can use the film badge dose data to obtain a radiation dose for a particular individual from that service. This is done upon request from the individual, the individual's representative, the Veterans' Administration, or others as authorized by the Privacy Act. Upon request, the participant or his or her authorized representative will be informed of the specific methodologies and assumptions employed in estimating his or her dose. The participant can use this information to obtain independent opinions regarding exposure.

(b) From 1945 through 1954, the DoD and Atomic Energy Commission (AEC) policy was to issue badges only to a portion of the personnel in a homogeneous unit such as a platoon of a battalion combat team, Naval ship or aircraft crew. Either one person was badged in a group performing the same function, or only personnel expected to be exposed to radiation were badged. After 1954, the policy was to badge all personnel. But, some badges were unreadable and some records were lost or destroyed, as in the fire at the Federal Records Center in St. Louis. For these reasons the Nuclear Test Personnel Review (NTPR) Program has focused on determining the radiation dose for those personnel (about 75,000) who were not issued film badges or for whom film badge records are not available.

(c) In order to determine the radiation dose to individuals for whom film badge data are not available, alternative approaches are used as circumstances warrant. All approaches require investigation of individual or group activities and their relationship to the radiological environment. First, if it is apparent that personnel were not present in the radiological environment and had no other potential for exposure, then their dose is zero. Second, if some members of a group had film badge readings and others did not—and if all members had a common relationship with the radiological environment—then doses for unbadged personnel can be calculated. Third, where sufficient badge readings or a common relationship to the radiological environment does not exist, dose reconstruction is performed. This involves correlating a unit's or individual's detailed activities with the quantitively determined radiological environment. The three approaches are described as follows:

(1) Activities of an individual or his unit are researched for the period of participation in an atmospheric nuclear test. Unit locations and movements are related to areas of radiation. If personnel were far distant from the nuclear detonation(s), did not experience fallout or enter a fallout area, and did not come in contact with radioactive samples or contaminated objects, they were judged to have received no dose.

(2) Film badge data from badged personnel may be used to estimate individual doses for unbadged personnel. First, a group of participants must be identified that have certain common characteristics and a similar potential for exposure to radiation. Such characteristics are: individuals must be doing the same kind of work, referred to as activity, and all members of the group must have a common relationship to the radiological environment in terms of time, location or other factors. Identification of these groups is based upon research of historical records, technical reports or correspondence. A military unit may consist of several groups or several units may comprise a single group. Using proven statistical methods, the badge data for each group is examined to determine if it adequately reflects the entire group, is valid for use in statistical calculations, or if the badge data indicate the group should be sub-divided into smaller groups. For a group that meets the tests described above, the mean dose, variance and confidence limits are determined. An estimated dose equal to 95% probability that the actual exposure did not exceed the estimate is assigned to unbadged personnel. This procedure is statistically sound and will insure that unbadged personnel are assigned doses much higher than the average/mean for the group.

(3) Dose reconstruction is performed if film badge data are unavailable for all or part of the period of radiation exposure. If film badge data are partially available but cannot be used statistically for calculations, special activities are indicated for specific individuals, or if other types of radiation exposures are indicated. In dose reconstruction, the conditions of exposure are reconstructed analytically to arrive at a radiation dose. Such reconstruction is not a new concept: it is standard scientific practice used by health physicists when the circumstances of a radiation exposure require investigation. The underlying method is in each case the same. The radiation environment is characterized in time and space, as are the activities and geometrical position of the individual. Thus, the rate at which radiation is accrued is determined throughout the time of exposure, from which the total dose is integrated. An uncertainty analysis of the reconstruction provides a calculated mean dose with confidence limits. The specific method used in a dose reconstruction depends on what type of data are available to provide the required characterizations as well as the nature of the radiation environment. The radiation environment is not limited to the gamma radiation that would have been measured by a film badge, but also includes neutron radiation for personnel sufficiently close to a nuclear detonation, as well as beta and alpha radiation (internally) for personnel whose activities indicate the possibility of inhalation or ingestion of radioactive particles.

§ 218.2 General procedures.

The following procedures govern the approach taken in dose determination:

(a) Use individual film badge data where available and complete, for determining the external gamma dose.

(b) Identify group activities and locations for period(s) of possible exposure.

(c) Qualitatively assess the radiation environment in order to delineate contaminated areas. If no activities occurred in these areas, and if no other potential for exposure exists, a no dose received estimate is made.

(d) If partial film badge data are available, define group(s) of personnel with common activities and relationships to radiation environment.

(e) Using standard statistical methods, verify from the distribution of film badge readings whether the badged sample adequately represents the intended group.

(f) Calculate the mean external gamma dose, with variance and confidence limits, for each unbadged population. Assign a dose equal to 95% probability that actual exposure did not exceed the assigned dose.

(g) If badge data is not available for a statistical calculation, conduct a dose reconstruction.

(h) For dose reconstruction, define radiation environment through use of all available scientific data, e.g., measurements of radiation intensity, decay, radioisotopic composition.

(i) Quantitatively relate activities, shielding, position, and other factors to radiation environment as a function of time. Integrate dose throughout period of exposure.

(j) Where possible, calculate mean dose with confidence limits; otherwise calculate best estimate dose or, if data are too sparse, upper limit dose.

(k) Compare calculations with available film badge records to verify the calculated doses.

(l) Whether or not film badge data is available, calculate initial and internal doses where identified as a meaningful contribution to the total dose.

§ 218.3 Dose reconstruction methodology.

(a) *Concept:* The specific methodology consists of the characterization of the radiation environments to which participants, through all relevant activities, were exposed. The environments, both initial and residual radiation, are corrected with the activities of participants to determine accrued doses due to initial radiation, residual radiation and/or inhaled/ingested radioactive material, as warranted by the radiation environment and the specific personnel activities. Due to the range of activities, times, geometries, shielding, and weapon characteristics, as well as the normal spread in the available data pertaining to the radiation environment, an uncertainty analysis is performed. This analysis quantifies the uncertainties due to time/space variations, group size, and available data. Due to the large amounts of data, an automated (computer-assisted) procedure is often used to facilitate the data-handling and the dose integration, and to investigate the sensitivity to variations in the parameters used. The results of the gamma data calculations are then compared with film badge data as they apply to the specific period of the film badges and to the comparable activities of the exposed personnel, in order to validate the procedure and to identify personnel activities that could have led to atypical doses. Radiation dose from neutrons and dose commitments due to inhaled or ingested radioactive material are not detected by film badges. Where required, these values are calculated and recorded separately.

(b) Characterization of the Radiological Environment.

(1) This step describes and defines the radiological conditions as a function of time for all locations of concern, that is, where personnel were positioned or where personnel activities took place. The radiation environment is divided into two standard categories—initial radiation and residual radiation.

(2) The initial radiation environment results from several types of gamma and neutron emissions. Prompt neutron and gamma radiation are emitted at the time of detonation, while delayed neutrons and fission-product gamma, from the decay of radioactive products in the fireball, continue to be emitted as the fireball rises. In contrast to these essentially point sources of radiation, there is gamma radiation from neutron interactions with air and soil, generated within a fraction of a second. Because of the complexity of these radiation sources and their varied interaction properties with air and soil, it is necessary to obtain solutions of the Boltzmann radiation transport equation. The radiation environment thus derived includes the effects of shot-specific parameters such as weapon type and yield, neutron and gamma output, source and target geometry, and atmospheric conditions. The calculated neutron and gamma radiation environments are checked for consistency with existing measured data, as available. In those few cases displaying significant discrepancies that cannot be resolved, an environment based on extrapolation of the data is used if it leads to a larger calculated dose.

(3) In determining the residual radiation environment, all possible sources are considered including radioactive clouds, radiation that may have been encountered from other tests, and radioactive debris that may have been deposited in water during oceanic tests. The residual radiation environment is divided into two general components—neutron-activated material that subsequently emits, over a period of time, beta and gamma radiation; and radioactive debris from the fission reaction or from unfissioned materials that emit alpha, beta, and gamma radiation. Because residual radiation decays, the characterization of the residual environment is defined by the radiation intensity as a function of type and time. Radiological survey data are used to determine specific intensities at times of personnel exposure. Interpolation and extrapolation are based on known decay characteristics of the individual materials that comprise the residual contamination. In these rare cases where insufficient radiation data exist to adequately define the residual environment, source data are obtained from the appropriate weapon design laboratory and applied in standard radiation transport codes to determine the initial radiation at specific distances from the burst. This radiation, together with material composition and characteristics, leads to description of the neutron-activated field for each location and time of interest. In all cases, observed data, as obtained at the time of the operation, are used to calibrate the calculations.

(c) *Activities of Participants.* This step uses all official records, augmented by personnel interviews were gaps exist, to depict a scenario of activities for each individual or definable group. When a dose reconstruction is performed for a specific individual, information available from the individual is accepted unless demonstrably inaccurate. For military units, whose operations were closely controlled and further constrained by radiological safety monitors, the scenario is usually well-defined. The same is true for observers, who were restricted to specific locations both during and after the nuclear bursts. Ships' locations and activities are usually known with a high degree of precision from deck logs. Aircraft tracks and altitudes are also usually well defined. Personnel engaged in scientific experiments often kept logs of their activities; moreover, the locations of their experiments are usually a matter of record. Where the records are insufficiently complete for the degree of precision required to determine radiation exposure, participants' comments are used and reasonable judgments are made to further the analysis. Possible variations in the activities, as well as possible individual deviations from group activities, with respect to both time and location, are considered in the uncertainty analysis of the radiation dose calculations.

(d) *Calculation of Dose.* (1) The initial radiation doses to close-in personnel (who were normally positioned in trenches at the time of detonation) are calculated from the above-ground environment by simulating the radiation transport into the trenches. Various calculational approaches, standard in health physics, are employed to relate in-trench to above-trench doses for each source of radiation. Detailed modeling of the human body, in appropriate postures in the trench, is performed to calculate the gamma dose that would have been recorded on a film badge and the maximum neutron dose. The neutron, neutron-generated gamma, and prompt gamma doses are accrued during such a short time interval that the posture in a trench could not be altered significantly during this exposure. The fission-product gamma dose, however, is delivered over a period of many seconds. Therefore, the possibility of individual reorientation (e.g., standing up) in the trench is considered.

(2) The calculation of the dose from residual radiation follows from the characterized radiation environment and personnel activities. Because radiation intensities are calculated for a field (i.e., in two spatial dimensions) and in time, the radiation intensity is determinable for each increment of personnel activity regardless of direction or at what time. The dose from exposure to a radiation field is obtained by summing the contribution (product of intensity and time) to dose at each step. The dose calculated from the radiation field does not reflect the shielding of the film badge afforded by the human body. This shielding has been determined for pertinent body positions by the solution of radiation transport equations as applied to a radiation field. Conversion factors are used to arrive at a calculated film badge dose, which not only facilitates comparison with film badge data, but serves as a substitute for an unavailable film badge reading.

(3) The calculation of the dose from inhaled or ingested radioactivity primarily involves the determination of what radioisotopes entered the body in what quantity. Published conversion factors are then applied to these data to arrive at the radiation dose and future dose commitments to internal organs. Inhalation or ingestion of radioactive material is calculated from the radioactive environment and the processes of making these materials inhalable or ingestible. Activities and processes that cause material to become airborne (such as wind, decontamination or traffic) are used with empirical data on particle lofting to determine airborne concentrations under specific circumstances. Volumetric breathing rates and durations of exposure are used to calculate the total material intake. Data on time-dependent weapon debris isotopic composition and the above-mentioned conversion factors are used to calculate the dose commitment to the body and to specific body organs.

(e) *Uncertainty Analysis.* Because of the uncertainties associated with the radiological data or calculations used in the absence of data, as well as the uncertainties with respect to personnel activities, confidence limits are determined where possible for group dose calculations. The uncertainty analysis quantifies the errors in available data or in the model used in the absence of data. Confidence limits are based on the uncertainty of all relevant input parameters, and thus vary with the quality of the input data. They also consider the possible range of doses due to the size of the exposure group being examined. Typical sources of error include orientation of the weapons, specific weapon yields, instrument error, fallout intensity data, time(s) at which data were obtained, fallout decay rate, route of personnel movements, and arrival/stay times for specific activities.

(f) *Comparison with Film Badge Records.* (1) Calculations of gamma dose were compared with film badge records for two military units at Operation PLUMBBOB to initially validate this methodology. Where all parameters relating to radiation exposure were identified, direct comparison of gamma dose calculations with actual film badge readings was possible. Resultant correlations provided high confidence in the methodology.

(2) Film badge data may, in some cases, be unrepresentative of the total exposure of a given individual or group; nevertheless, they are extremely useful for direct comparison of incremental doses for specific periods, e.g., validating the calculations for the remaining, unbadged period of exposure. Moreover, a wide distribution of film badge data often leads to more definitive personnel grouping for dose calculations and to further investigation of the reason(s) for such distribution. In all cases, personnel film badge data are not used in the dose calculations, but rather are used solely for comparison with and validation of the calculations. For dose reconstructions accomplished to date, comparison has been favorable and within the confidence limits of the calculations.

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[FR Doc. 83-6297 Filed 3-11-83; 8:45 am]

BILLING CODE 3810-01-M

POSTAL SERVICE

39 CFR Part 111

Domestic Mail Manual; Miscellaneous Amendments

AGENCY: Postal Service.

ACTION: Final rule.

SUMMARY: The Postal Service hereby describes the numerous miscellaneous revisions consolidated in the Transmittal Letter for Issue 11 of the Domestic Mail Manual (DMM), which is incorporated by reference in the Federal Register, 39 CFR 111.1

Most of the revisions are minor, editorial or clarifying. Substantive changes, such as the increase in rates for preferred rate mailers, have previously been published in the Federal Register.

EFFECTIVE DATE: January 20, 1983.

FOR FURTHER INFORMATION CONTACT: Paul J. Kemp, (202) 245–4638.

SUPPLEMENTARY INFORMATION: The Domestic Mail Manual, which is incorporated by reference in the Federal Register (see 39 CFR 111.1) has been amended by the publication of a transmittal letter for issue 11, dated January 20, 1983. The text of all published changes is filed with the Director of the Federal Register. Subscribers to the Domestic Mail Manual receive these amendments automatically from the Government Printing Office.

The following excerpt from the Summary of Changes section of the transmittal letter for issue 11 covers the minor changes not previously described in interim or final rules published in the Federal Register.

Note.—Issue 11 contains all DMM revisions published between August 5, 1982 and January 20, 1983 (PB 21351 through 21387).

B. SUMMARY OF CHANGES

Major Revisions

1. * * *

2. *Post Office Boxes.* The term "lockbox" has been replaced by the term "post office box". Therefore, Exhibit 113.66, sections 155, 156, 323, 367, 467, 622, 667, 912, 951, 952, 953, and the Index are revised to replace the term "lockbox" with the term "post office box" (PB 21263, 8–5–82).

General Counsel of the Department of Defense,
Washington, D.C., September 4, 1981.

Hon. G.V. (Sonny) Montgomery,
Chairman, Committee on Veterans' Affairs, House of Representatives, Washington, D.C.

Dear Mr. Chairman: The purpose of this letter is to provide the views of the Department of Defense on one aspect of H.R. 3499, 97th Congress, a bill "To amend title 38, United States Code, to extend the Vietnam-era veterans' readjustment counseling program, to provide medical care for Vietnam veterans exposed to herbicide defoliants (including Agent Orange), to recover the cost of certain heath care provided by the Veterans' Administration, and for other purposes."

H.R. 3499 was passed by the House on June 2, 1981. As passed by the House, the bill did not include any reference to radiation. The Senate bill on this subject, S. 921, as reported out of committee, was similarly silent on this point. However, on passage of the legislation by the Senate (H.R. 3499, amended), provisions in section 3 relating to medical care for veterans who participated in the atmospheric nuclear weapons testing program hereinafter referred to as "selected veterans," were added as a result of a Senate floor amendment. Thus, this amendment has not had the benefit of hearings or the comments of interested agencies.

The Department of Defense has consistently attempted to assure that legislation relating to Department of Defense programs and personnel is fair and reasonable to both veterans and taxpayers. H.R. 3499, in its present form, is not.

Through programs administered by the Veterans' Administration, Congress has established a comprehensive, no fault system of disability compensation for veterans who suffer service connected disabilities. Medical care and treatment in Veterans's Administration facilities are provided as part of that compensation. Veterans who are unable to pay for necessary health care may, even though they suffer no service connected disability, also be eligible for medical care and treatment in Veterans' Administration facilities. We have every reason to believe that the Veterans' Administration administers both of these programs in a fair and even handed manner and that all veterans have an equal opportunity to establish their rights to benefits.

Legislation such as H.R. 3499 which singles out a group of selected veterans for special benefits above and beyond that available to all veterans should only be adopted when there is a credible medical or scientific basis for affording such treatment. In the case of the provisions of H.R. 3499 concerned with radiation exposure there is no such basis.

Since December 1977 the Department of Defense, acting through the Defense Nuclear Agency, has been engaged in an extensive research program designed, in part, to identify the Department of Defense participants in the atmospheric nuclear testing program and to determine the extent of radiation to which these individuals may have been exposed. This research has established that most exposures to Department of Defense personnel during the tests were quite low—averaging about half a rem. (A rem is a unit of radiation dose equivalent and reflects the radiation energy deposited within the body tissue and its capability of causing an effect.) Based upon research to date it appears that only a small number (less than one percent) received doses above today's allowable Federal guidelines.

The health effects of exposure to low levels of ionizing radiation have been considered by numerous national and international authorities. All agree that the increased risk associated with exposure to radiation at the levels experienced by the selected veterans is quite low—about .01 percent for each rem of low level exposure. Applying established risk estimates to the known radiation environment during the atmospheric testing period, we would anticipate approximately 12 excess cancer fatalities among the 250,000 Department of Defense participants as a result of radiation exposure. This may be compared to the estimatd 40,000 cancer fatalities in the same population which would *not* be associated with radiation exposure. In the face of these facts, we believe that there is no sound medical or scientific basis for according to these selected veterans needed benefits above those already available to them as veterans.

The extension of medal care to the selected veterans was characterized on the Senate floor as involving no additional cost because existing Veterans' Administration facilities could be used. However, it should be pointed out that this provision would extend medical care to an additional population of approximately 250,000 atmospheric test participants who would be replacing other veterans eligible for care.

We are more concerned, however, with the perceptions among both veterans and the general public which would result from enactment of H.R. 3499 as passed by the

Senate. Section 3 of the Senate passed bill creates the unmistakeable impression that exposure to low-level ionizing radiation is a significant health hazard when available scientific and medical evidence simply does not support that contention. This mistaken impression has the potential to be seriously damaging to every aspect of the Department of Defense's nuclear weapons and nuclear propulsion programs. The legislation could adversely affect our relations with our European allies, impact upon the civilian nuclear power industry, and raise questions regarding the use of radio-active substances in medical diagnosis and treatment.

For the reasons stated above, the provisions section 3 of H.R. 3499 concerned with radiation exposure as passed by the Senate should be deleted from the bill.

The Office of Management and Budget advises that, from the standpoint of the Administration's program, there is no objection to the presentation of this report for the consideration of the Committee.

Sincerely,

WILLIAM H. TAFT IV.

Hearings: O&I

June 7, 1983

Lieutenant General Harry A. Griffith
Director, Defense Nuclear Agency
c/o Office of Legislative Affairs
Room 3D918, The Pentagon
Washington, DC 20301

Dear General Griffith:

During an Oversight and Investigations Subcommittee hearing on May 24, 1983, witnesses from the National Association of Atomic Veterans testified about certain documents from the files of Colonel Stafford Warren. According to the witnesses, these documents were declassified in 1964; and at some later date they were turned over to the library of the University of California at Los Angeles.

In order to respond to an inquiry made during the hearing by the Honorable Bob Edgar, I request that you research and provide answers to the following questions by Tuesday, June 21, 1983:

1. How were these particular documents declassified, i.e., describe when, where, and by whom?

2. Has there ever been any type of cataloging, listing, or summarizing of these documents either before or after the declassification process?

3. When did DNA (or any other agent of DOD) become aware of the existence and/or whereabouts of the original documents?

4. Has DNA (or any other agent of DOD) accomplished any type of analysis or study of the original documents either before or after the declassification process?

My staff has sent a copy of the transcript of the May 24, 1983, hearing to your office of Legislative Affairs. If you have any questions, please contact Richard Shultz at 225-3541.

Sincerely,

G. V. (SONNY) MONTGOMERY
Chairman

RS:be

DEFENSE NUCLEAR AGENCY
WASHINGTON, D.C. 20305

23 JUN 1983

Honorable G. V. Montgomery
Chairman, Committee on
  Veterans' Affairs
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

I am pleased to have this opportunity to respond to your letter of June 7, 1983, in which you inquired about the declassification of documents in the Stafford Warren collection and requested information as to when the Defense Nuclear Agency (DNA) became aware of the collection. The exact circumstances surrounding the declassification are not yet clear. Many of the documents were apparently declassified by predecessor agencies of the Department of Energy (DOE) several years ago. We are working with DOE to determine the specific details and this information will be provided to you as soon as it is available.

Preliminary information provided to us indicates that the Stafford Warren collection was donated by his family to the University of California at Los Angeles (UCLA) Biomedical Library after Colonel Warren's death last year. On May 18, 1982, UCLA requested that DOE (Los Angeles Security Office) conduct a classification review and forwarded the documents to DOE for that purpose. The review was conducted and all of the documents were found to be unclassified. DOE and UCLA agree that all of the documents were returned to UCLA.

The documents are not yet completely catalogued, listed, or summarized and we are not aware of any pre-declassification listings. However, the documents were partially catalogued by Colonel Warren's family and UCLA has since continued that effort. In addition, DNA is now indexing some of the documents in the course of our ongoing analysis.

In April of 1983 the DNA contractor working on the reports for Operations CROSSROADS and SANDSTONE learned of the existence and location of the Stafford Warren collection. Although neither the size nor the content of the collection was known, the contractor reported the existence of this potential resource to DNA on April 15, 1983. Inasmuch as Colonel Warren was the author of many of the official CROSSROADS documents already reviewed by DNA, it did not seem likely that the Stafford Warren collection would contain any significant new information; therefore, the collection was not brought to the attention of the Director, DNA. Nevertheless, the repository was added to the more than 100 archives and libraries already searched or to be searched in the course of our research effort. Our contractor began to examine the Stafford Warren collection on May 24, 1983, the day of the hearing before your committee. After the hearing, we also dispatched a team of DNA personnel to examine the documents.

DNA is presently reviewing the Warren collection. After analyzing the documents, DNA would welcome the opportunity to brief you and the Committee on Veterans' Affairs on the content of the collection, and its implications on the overall Nuclear Test Personnel Review program.

If I can be of any additional assistance, please let me know.

Sincerely,

Harry A Griffith
HARRY A. GRIFFITH
Lieutenant General, USA
Director

STATEMENT OF
D. EARL BROWN, M.D.
ASSOCIATE DEPUTY CHIEF MEDICAL DIRECTOR
OF THE
VETERANS ADMINISTRATION
BEFORE THE
SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS
OF THE
COMMITTEE ON VETERANS' AFFAIRS
UNITED STATES HOUSE OF REPRESENTATIVES
MAY 24, 1983

Mr. Chairman and Members of the Subcommittee:

I am pleased to appear before the subcommittee this morning to discuss important issues related to the exposure of veterans to ionizing radiation during military service. This forum is a welcome opportunity to describe the VA's program, under Public Law 97-72, to provide medical examinations, care, and treatment for veterans with disabilities which may be associated with radiation exposure.

In January 1978, the VA began a program to provide a medical examination, upon request, to any veteran who participated in the nuclear weapons testing program. At that time, a medical examination protocol was developed which required that a history of exposure be elicited from the veteran. It also required peformance of a complete physical examination with particular attention being paid to organs thought to be most commonly affected by exposure to radiation.

In March 1979, in cooperation with DNA, VA began a notification and medical examination program for all weapons test participants with recorded ionizing radiation doses in excess of 25 rem. At the time, 25 rem was the recommended maximum allowable exposure for persons receiving a one-time planned exposure in an emergency situation. A new medical examination protocol was developed for use in the new program. It was also used for the general examination program which had begun the year before. The notification and examination program was expanded, in June 1979, to include all weapons test participants with recorded annual dosages in excess of 5 rem.

With enactment of Pub. L. No. 97-72 in 1981, the VA received special authority to provide hospital and nursing home care and limited outpatient services to certain veterans exposed to ionizing radiation. The law authorized care for such veterans who participated in the nuclear weapons testing programs, or who served with the occupation forces in Hiroshima and Nagasaki, Japan. Care was authorized for any disability which may be associated with exposure to ionizing radiation, notwithstanding that there may not be sufficient medical evidence to determine that the individual's disorder was caused by the exposure.

Initial guidelines implementing Pub. L. No. 97-72 authorized VA to provide eligible veterans with care and treatment for cancer and thyroid nodules. Those guidelines provided that all other conditions are not ordinarily attributable to exposure to ionizing radiation. Following complaints that the eligibility guidelines were too restrictive, particularly when compared with similar guidelines related to agent orange, the radiation guidelines were thoroughly reviewed. We determined that we could, consistent with the intent of Congress when Pub. L. No. 97-72 was enacted, revise the guidelines to allow treatment for all conditions except those which are known to have causes other than exposure to ionizing radiation. Accordingly, the guidelines were amended on April 6, 1983.

Health care personnel responsible for treating veterans for illnesses possibly associated with radiation exposure must be aware of developments in scientific and medical understanding of diseases for which treatment is being offered, including research on the etiology of the diseases.

To this end, we are, together with the Society of Nuclear Medicine, preparing a detailed manual for use by health care personnel that will assist them in treating veterans with illnesses which may be related to radiation exposure. It will set forth examination protocols identifying organs or organ systems which particularly should be examined. It will also serve as a basic resource tool and contain reference material, specifically abstracts from pertinent articles.

VA is also in the process of setting up a system to maintain accurate records regarding both the numbers of veterans seeking examination and treatment under Pub. L. No. 97-72, and the disabilities for which treatment is sought. This tracking system will be the same as that being used to gather similar data for veterans receiving care and treatment for agent orange related disabilities. When this system is firmly in place, we will be able to obtain aggregate information on how many veterans are being treated under the authority of Public L. No. 97-72 for care for disabilities which may be related to exposure to ionizing radiation.

Finally, VA is preparing a pamphlet which will describe the medical benefits authorized by the law, and which will provide information on how to obtain examination and treatment. This pamphlet will be made widely available to veterans.

That concludes my prepared statement. I will be happy to answer any questions the Chairman or other members of the Subcommittee may have.

Veterans Administration
Department of Medicine and Surgery
Washington, D.C. 20420

CIRCULAR 10-83-61
April 5, 1983

TO: Regional Directors; Directors, VA Medical Center Activities, Domiciliary, Outpatient Clinics, and Regional Offices with Outpatient Clinics

INFO: Directors, Regional Offices; District Counsels

SUBJ: Guidelines for Implementation of Legislation Related to the Provision of Health Services to Veterans Exposed to Ionizing Radiation As a Result of Detonation of Nuclear Devices

1. The "Veterans' Health Care, Training, and Small Business Loan Act of 1981" was signed into law on November 3, 1981. The Act, Public Law 97-72, authorizes the Veterans Administration to provide certain health care services, as described in paragraph 3, to veterans who, while serving on active military duty, were exposed to ionizing radiation from the detonation of nuclear device as a result of participation in either the testing of such a device between 1945 and 1962, or the American occupation of Hiroshima or Nagasaki, Japan, between September 11, 1945, and July 1, 1946. Verification of service at a site during the testing of nuclear devices, or in Hiroshima/Nagasaki during the occupation of Japan, during the times specified will be required. In the absence of affirmative evidence to the contrary, a veteran's contention of exposure at a nuclear device testing site, or in Hiroshima/Nagasaki will be accepted.

2. Health care services may not be provided under this law for the care of conditions which are found to have resulted from a cause other than the specified exposures.

3. Health care services authorized under this provision are limited to hospital and nursing home care in VA facilities and outpatient care in VA facilities on a pre- or post-hospitalization basis or to obviate a need for hospitalization. Such health care services will be provided without regard to the veteran's age, service connected status or the inability of the veteran to defray the expenses of such care. Veterans furnished outpatient care under this authority will be accorded priority ahead of other nonservice-connected veterans and equal to former Prisoners of War who are receiving care for nonservice-connected conditions. Congress made it clear that this law provides for health care only, and that a determination that the veteran is eligible for such care does not constitute a basis for service connection or in any way affect determinations regarding service connection.

4. Each veteran who participated in the testing of a nuclear device or who participated in the occupation of Hiroshima or Nagasaki, Japan, between September 11, 1945, and July 1, 1946, and who requests VA medical care will be provided a physical examination and appropriate diagnostic studies in accordance with DM&S Circular 10-83-12. The examination and studies will be documented in the medical record. If such an examination has been completed within the prior six months, only those procedures which are medically indicated by the current circumstances need be repeated. Where the findings reveal a condition requiring treatment, the responsible staff physician shall make a determination as to whether that condition resulted from a cause other than the veteran's exposure to ionizing radiation.

THIS CIRCULAR EXPIRES ON APRIL 5, 1984

2.1

Enclosure (2)

Veterans who meet the criteria of this circular may be treated under this authority. In making this determination, the physician should consider that the following types of conditions are not ordinarily considered to be due to such exposure:

a. Congenital or developmental conditions, e.g., spina bifida; scoliosis

b. Conditions which are known to have pre-existed military service.

c. Conditions resulting from trauma, e.g., deformity or limitation of motion of an extremity.

d. Conditions having a specific and well established etiology, e.g., tuberculosis; gout.

e. Common conditions having a well recognized clinical course, e.g., inguinal hernia; acute appendicitis.

5. On occasion, the responsible staff physician may find that a veteran requires care for one or more of the conditions listed in paragraph 4, but that the case presents complicating circumstances that make the provision of care under this authority appropriate. In such instances, the physician should seek guidance from the Chief of Staff and the Environmental Physician regarding authorization for treatment. If treatment is so authorized, the reasons will be clearly documented in the medical record. Veterans who are not provided needed medical care under this circular may be furnished care if they are eligible under any other statutory authority.

6. In the event the responsible staff physician finds that a veteran has a condition not ordinarily considered to be due to the specified exposure and there are not complicating circumstances warranting the provision of care under this authority, the decision and its basis will be clearly documented in the medical record.

7. The provisions of this circular will not exclude any veteran who alleges exposure to ionizing radiation as described in paragraph 1 of this circular from being included in a VA Radiation Exposure Registry Program, under development.

8. These guidelines will be effective upon receipt. A copy of the pertinent guidelines should be made available to any veteran seeking care under this authority.

9. This circular rescinds DM&S Circular 10-82-246 dated December 21, 1982.

W. J. JACOBY, JR., M.D.
Deputy Chief Medical Director

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639665-P

DEPARTMENT OF HEALTH & HUMAN SERVICES
Public Health Service
Centers for Disease Control
Atlanta, Georgia 30333

STATEMENT

BY

GLYN G. CALDWELL, M.D.
DEPUTY DIRECTOR, CHRONIC DISEASES DIVISION
CENTER FOR ENVIRONMENTAL HEALTH
CENTERS FOR DISEASE CONTROL

BEFORE THE

COMMITTEE ON VETERANS' AFFAIRS
COMMITTEE ON OVERSIGHT AND INVESTIGATIONS
NITED STATES HOUSE OF REPRESENTATIVES

May 24, 1983

Mr. Chairman and Members of the Committee:

Thank you for this opportunity to discuss the epidemiologic study being conducted by the Centers for Disease Control (CDC) concerning persons present at the atmospheric nuclear test Smoky. I am Dr. Glyn G. Caldwell, Deputy Director, Chronic Diseases Division, Center for Environmental Health, the CDC lead epidemiologist for this investigation. For your convenience, I will review some of the information which we presented to the Senate Veterans Affairs Committee in 1979, and then provide the latest results of our investigation.

In late November 1976, a former CDC physician epidemiologist working at the Veterans Administration (VA) hospital in Salt Lake City, Utah, learned of a patient with acute myelocytic leukemia who reported having been present at an atmospheric nuclear test in Nevada. The nuclear test, named Smoky, took place on August 31, 1957. The physician contacted CDC because of CDC's interest in cancer cases or case clusters occurring in unusual circumstances. When cancer or leukemia is found in association with apparently unusual animal, chemical, viral, or radiation exposures, such cases deserve epidemiologic investigation, both as a service to State and local health departments and as a mechanism for developing hypotheses concerning disease causation.

Since ionizing radiation is a well-known cause of cancer and particularly of leukemia, the case reported to CDC, if in fact it was at all related to nuclear radiation exposure, raised two possibilities: (1) that radiation levels previously thought safe might actually be carcinogenic or (2) that radiation exposure during nuclear tests might have been greater than originally supposed. In an attempt to review these possibilities, CDC proposed to identify all persons present at Smoky and then to determine the subsequent incidence of cancer and leukemia in this population.

Initial inquiries made to the Energy Research and Development Agency (ERDA), now the Department of Energy (DOE), confirmed that nuclear tests had occurred involving troop exposure but that radiation had apparently been within accepted safe limits. Numerous telephone inquiries were then made attempting to identify those individuals who were present at Smoky. We were seeking identification of military and civilian groups present, names of persons, their ages or dates of birth, specific dates of exposure, sources of current addresses, and, finally, whatever information might be recorded concerning cases of cancer or leukemia within these groups.

In early 1977, the Salt Lake City VA patient's story appeared in the news media. Subsequently, CDC received numerous telephone calls and letters concerning persons thought to have been present at nuclear tests. Among these was a letter from a second leukemia patient who had also been present at Smoky. Additional media coverage resulted in many letters and telephone calls from individuals present at various nuclear tests and installations beginning with the Manhattan Project in 1945. We also received letters from a number of leukemia and cancer patients or members of their families stating that they or someone in their family had been present at Smoky or nuclear tests in other years. From over 2,000 such contacts, we were able to identify 447 persons actually present at Smoky, and to discover three additional cases of leukemia among Smoky participants.

One of our early contacts was with the Armed Forces Radiobiology Research Institute (AFRRI) in the Department of Defense (DOD) where we learned that no systematic records concerning persons exposed during testing had been kept during the 1940s and 1950s, but that, beginning in 1964, some data had been assembled retrospectively. These records were said to contain name, year of exposure, amount of radiation received, and, in some instances, serial number, permanent duty station, test exercise unit, service number, social security number, and rank. If CDC could provide names, service numbers, and social security numbers--data which we did not have at that time--it appeared that the AFRRI might be able to provide radiation exposure data. To explore this possibility further we contacted the Surgeon General of the Army on April 25, 1977.

A list of military units present at Smoky was identified, and AFRRI located a microfilm of radiation film badge records developed at the Lexington Signal Depot. From these two sources, a list of Army participants was compiled and forwarded to CDC on August 19, 1977. The list provided name, serial number, rank, unit, and film badge radiation dose for 3,153 persons present at Smoky.

As soon as this list became available, systematic efforts were begun to locate as many participants as possible and to identify cases of cancer or leukemia among this group of persons.

The first effort was to compare the AFRRI list with all letters and telephone contacts to sort out those individuals actually present at Smoky. We then matched these names against the diagnostic and consultative files of the Armed Forces Institute of Pathology. From this procedure two additional leukemia cases were identified.

The second effort was to match the list of names against the VA death benefit files. This task led to the discovery of another leukemia case, bringing the total number of leukemia cases to eight as of January 1978. In addition, the VA compared the list to their compensation and claims files (BIRLS) searching for addresses, birth dates, other identifiers, and information about health status. From this search, we obtained additional information on 1,231 participants.

Next, we forwarded the remainder of the list to the National Personnel Record Center (NPRC) in St. Louis. They searched their files for addresses, birth dates, social security numbers, and other information. NPRC searches included active duty roles, reserve, and reserve retired roles, and some additional searches through the VA (BIRLS) system when additional information indicated that such contact was likely to be fruitful. We received information on nearly 800 of the 1,300 names forwarded to NPRC.

Following this search, three systems were queried in parallel: the Social Security Administration (SSA); the Federal Bureau of Investigation (FBI); and the Internal Revenue Service (IRS).

Military personnel were not required to have a Social Security number in 1957. We sought one from the SSA where name, place of birth, birth date, and military serial number were available. Approximately 70% of the 487 names sent were found to have a Social Security number.

The FBI was asked to search its files because most participants had security clearances during their military service. Nearly 80% of the 821 names sent were found to have some information of value in the security files.

Our final source of current addresses was the IRS, which searched its records if a Social Security number was available. Addresses were located for more than 91% of the 821 names forwarded to IRS.

Once CDC received an address from any source, a letter was sent to the individual seeking to confirm his participation and ascertain health status. In addition, we requested copies of orders documenting participation and requested names and addresses of other participants if known.

A number of problems were encountered during the investigation, which for the most part have been solved or somehow overcome. These problems were: lack of participant identification, incomplete records, legal constraints on data use, the Privacy Act, confidentiality of hospital records, refusal of participants to take part in the study, inability to locate next of kin, and finally lack of response from participants.

Initially we faced a two-fold problem: Where could we obtain a list of participants, and what information would be available on those participants? From the beginning in late 1976, the first goal was to obtain such a list, although we expected only a small group to be identified. The first time we became aware that more people were involved than had originally been suspected was when we obtained a list of units and a tally of the number of participants (2,235) from the "after-action" report.

In August 1977, the Surgeon General of the Army provided a list of 3,153 persons who had a film badge on August 31, 1957. As additional individuals and groups were identified and their attendance confirmed, they were added to the study group.

Once the list was established we found that identifiers were quite sparse and that we would have difficulty using the list with some data systems (e.g., IRS could use Social Security number only). Furthermore, addresses and information might be in any one of several data banks, not all of which were computerized (SSA was not).

There were also issues of privacy, and allowability of disclosure under the Privacy Act. Early in the investigation, CDC was not listed in the routine uses in the Privacy Act system notices as a user of VA, DOD, DOE, or IRS records. This was dealt with by listing CDC as a records user for research in the system notices in the Federal Register under conditions which limited the use of the records to health research. The Surgeon General of the Army released the first list as a matter of medical urgency. IRS permitted the

National Institute for Occupational Safety and Health (NIOSH), within CDC, to obtain recent addresses from IRS records under a provision of the Internal Revenue Code that permits disclosures to NIOSH for occupational health purposes. However, we still had difficulty obtaining records from hospitals, particularly when an individual had died and we had not been able to contact the next of kin for a medical records release permit. This was an inconvenience, but we obtained data in some cases by direct contact with the hospital pathologist for confirmation of diagnoses and even an address of the next of kin. Such physician-to-physician contact is useful but very time-consuming, and should be resorted to only when other possibilities have been exhausted.

To date, we have confirmed that 3,217 persons were present during the detonation of Smoky on August 31, 1957. We cannot locate or determine the vital status of only 145. Of the remaining 3,072 (95.5% of the total), we have reviewed the death certificates of the 146 who are deceased and contacted the remaining 2,926 participants or their next of kin. Only 20 of those contacted refused to be included in the study.

Because cancer has been the primary cause of illness and death, attributable to atomic radiation exposure, we collected information on cancer as we located and contacted the Smoky nuclear test participants. Our current estimate of expected cancer incidence in the Smoky population is 117.5, compared with the 112 cases identified in these participants to date. The difference between the number of expected and observed cases is not statistically significant. For all types of cancers analyzed separately except leukemia, the difference between the number of expected cases and observed cases was not statistically significant. However, we have confirmed that 10 participants have leukemia or have died of that disease. Using United States incidence rates from either the National Cancer Institute Third National Cancer Survey or Surveillance Epidemiology and End Results Program, these 10 observed cases can be compared with the 4.0 cases expected in a group of this size. This finding is statistically significant (Poisson p=.008).

According to United States mortality statistics, 365 deaths from all causes would have been expected in this population to date. In fact, there have been 320 deaths in Smoky participants.

We also calculated the expected number of cancer deaths for this population to be 64.3. In fact, we found 64. Of deaths from leukemia, however, 9 were found compared to 3.1 expected. This difference is statistically significant (Poisson p=.014).

One other disease, polycythemia vera, has also been found to have occurred at a higher than expected frequency in these nuclear test participants. We expected no more than 1 case but found 4. This disease, which is characterized by an inappropriate increase in the number and production of red blood cells (erythrocytes), has not been previously shown to be caused by ionizing radiation.

A manuscript reporting the overall mortality and cancer incidence data highlighted here has been submitted to and accepted by the Journal of the

American Medical Association. The report of the polycythemia vera findings is being prepared for submission to a medical journal so that this information, too, will be widely available to the medical community.

In summary, our most significant findings to date are an increased frequency of the occurrence of leukemia and polycythemia vera. We found no evidence of an increased frequency of cancer or death from cancer, but we did observe less than the number of total deaths expected.

We plan to continue our followup studies. The protocol for a 25-year followup is now being prepared. Other studies are being done on nuclear test participants by the National Academy of Sciences National Research Council.

Mr. Chairman, this is the present status of CDC's work on the incidence of cancer and leukemia and overall mortality in the nuclear test participants at Smoky. I will be happy to answer any further questions that you or other members of the Committee may have.

AUG 22 1983

August 17, 1983

The Honorable Bob Edgar
House of Representatives
Washington, D.C. 20515

Dear Mr. Edgar:

As you requested at the hearing on the health effects of low level radiation exposure experienced by certain veterans held May 24, 1983, I am sending the latest report on the epidemiologic study conducted by the Centers for Disease Control concerning persons present at the atmospheric nuclear test Smoky.

If I can be of further assistance, do not hesitate to let me know.

Sincerely yours,

Glyn G. Caldwell, M.D.
Deputy Director, Chronic
Diseases Division
Center for Environmental Health

Enclosure

→ cc:
The Honorable G. V. (Sonny) Montgomery
Chairman, Veteran's Affairs Committee
House of Representatives

Original Contributions

Mortality and Cancer Frequency Among Military Nuclear Test (Smoky) Participants, 1957 Through 1979

Glyn G. Caldwell, MD; Delle Kelley; Matthew Zack, MD; Henry Falk, MD; Clark W. Heath, Jr, MD

• Follow-up of health status has been completed through 1979 for 3,072 (95.5%) of 3,217 nuclear test participants on military maneuvers during the 1957 nuclear test "Smoky." In these participants, 112 cases of cancer were diagnosed, compared with 117.5 cases expected. During the same follow-up period (1957 through 1979), 64 persons died of cancer, compared with an expected 64.3. Statistically significantly increased frequency of occurrence and mortality was found only for leukemia. The amount of cumulative gamma radiation exposure for 1957 ranged from 0 to 10,397 mrem as measured by individual personnel film badges. Although uncertainty remains about the exact amount of radiation exposure, the lack of a significant increase after 22 years in either the incidence of or the mortality from any other cancer and the apparent lack of a dose effect by unit lead to the consideration that the leukemia findings may be attributable either to chance, to factors other than radiation, or to some combination of risk factors possibly including radiation.

(*JAMA* 1983;250:620-624)

IN LATE 1976, the Centers for Disease Control in Atlanta learned of the diagnosis of acute myelocytic leukemia in a veteran exposed to ionizing radiation during the nuclear test "Smoky," detonated Aug 31, 1957. We undertook a follow-up study to identify and locate all test participants and to ascertain their health status and causes of death during the following 22 years.

See also pp 617, 618, 640, and 645.

We have previously reported the background information, described the study's general methodology, and discussed the evidence for an increased incidence of leukemia in this group.[1] This report adds information on incidence of other neoplastic diseases and on mortality from all causes.

SUBJECTS AND METHODS

As reported previously,[1] many sources provided identifying, locating, and health status data about the Smoky test participants, since no single source contained all the needed information. Table 1 outlines these sources and the information each provided.

Once we identified the participants, we attempted to contact each one or his or her next of kin, inquire about health status, and request permission to review pertinent medical records (Table 2).

We excluded two groups from the analysis—Canadian participants (92), whose follow-up was less complete than that of US military personnel, and the five women present on Aug 31, 1957. Follow-up of the Canadian participants is extremely limited, because we were unable to obtain adequate identification data to use for locating them. The women were excluded because, with so few, no meaningful conclusions could be drawn.

The remaining number of military participants was 3,217. Of these, we were able to follow up (by death certificate, refusal, or direct contact) 3,072 (95.5%). A small number (95) could not be contacted despite many attempts, and 50 others had no known address in any of the sources in Table 1.

If a participant reported a malignant neoplasm, we attempted to confirm the presence and type of neoplasm by obtaining the pertinent medical records and any biopsy, autopsy, or surgical pathology reports from his physician(s) or hospital(s) (Table 3). Where the only available document was the death certificate and we could not locate the next of kin, we attempted to confirm the diagnosis through the physician or hospital listed on the death certificate. Where only history

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From the Chronic Diseases Division, Center for Environmental Health, Centers for Disease Control, Atlanta.

Reprint requests to Chronic Diseases Division, Center for Environmental Health, Centers for Disease Control, 1600 Clifton Rd, Atlanta, GA 30333 (Dr Caldwell).

Table 1.—Sources Contacted for Data About Current Locations of Smoky Participants

Organization	Information Provided
Veterans Administration	Death certificates, addresses, medical records
Department of Energy	Dosimetry information
Department of Defense	Names received by toll-free telephones: 100 from Smoky participants
Social Security Administration	Social Security account numbers (SSANs) and mortality information where needed
Internal Revenue Service	Address through National Institute of Occupational Safety and Health when SSAN and address available
Federal Bureau of Investigation	Birthdates and places of birth
National Personnel Records Center	Identifying data and addresses, medical records, casualty reports—complete
National Academy of Sciences, National Research Council, Follow-up Agency	Dates of birth and death, SSAN, serial number, and death certificates

Table 2.—Results of Search for Nuclear Test Participants

Category	No.	%
Persons located and contacted	3,072	95.5
Contacted, all information provided	2,541	79.0
Contacted only	365	11.4
Refusal	20	0.6
Death certificate only	146	4.5
Persons not contacted	145	4.5
Total	3,217	100.0

Table 3.—Source of Confirmatory Data on Malignant Neoplasms for Smoky Participants

Source	No. of Cancers,* by ICDA† Code No.	
	140-207, 230-239	173 (Skin)
Medical records, including biopsy, autopsy reports, or both	90	21
Medical records review and clinical data only	13	8
Death certificate only	1	. . .
History only	8	8
Total	112	37

*Some persons had more than one primary cancer.

†ICDA indicates International Classification of Diseases, Adapted, eighth revision.

or death certificate is listed, we either could not identify or locate the next of kin or the hospital(s) of diagnosis, found that the hospital or physician kept no record, or were denied a request for data because we lacked a signed medical record release.

We accepted the cause of death for conditions other than malignant neoplasm as recorded on the death certificate after applying the usual nosological rules.[1]

Person-years at risk were used for calculating the expected incidence and mortality. Cases of persons dying during any calendar year were deleted at the end of that year.

The life-table methods used for calculating the number of cases or deaths expected to occur in the group and the statistical methods used were reported previously.[1,2] Expected incidence was calculated by applying age- and sex-specific rates for the person-years accumulated by the Smoky cohort from 1957 through the end of 1979 (22 years). Expected mortality was calculated from US rates for 1970 in relation to the period from mid-1957 through 1979 (22 years).[1] The level of statistical significance is .05. The 95% two-sided confidence limits have been calculated for the observed-to-expected ratio of cases and deaths.[4]

The gamma radiation exposure data are cumulative, as reported on all film badges for 1957. No primary data are available for other radiation types (eg, neutrons and alpha particles), and the data for beta radiation exposure are virtually limited to the Smoky film badges.

RESULTS

Incidence of Neoplasms

The number of newly diagnosed cancer cases (112) does not exceed the number expected (117.5) for the 22-year follow-up (Table 4). Only cancers of the buccal cavity and pharynx, melanoma of the skin, breast, eye and orbit, and brain and nervous system, lymphoma and leukemia, cancers of all types not listed, and cancers with unknown site occurred more often than expected. However, the leukemias showed a statistically significantly increased incidence ($P<.01$). All cancers not listed and cancers of unknown site (International Classification of Diseases, Adapted, eighth revision, 195-199, 230-239) are also statistically significantly increased ($P<.02$). This group includes either primary or secondary tumors with inadequate or, occasionally, no evidence of the primary site recorded in records available to us. Occasionally, "cancer" was recorded even though no data clearly specified the malignant nature. However, we believe that in many instances (especially from the earlier cases), we were simply unable to obtain a complete record. Cancers of the digestive, respiratory, genital, and urinary systems occurred less often than expected. No cases of cancer of either bones and joints, soft tissues, endocrine system, or multiple myeloma were found.

We previously reported information about the dates of birth, diagnosis, and cumulative gamma radiation exposure in 1957 for the leukemia cases.[1] Since that report, we have identified and confirmed by medical records review an additional case of chronic myelocytic leukemia diagnosed in 1978. This case occurred in a participant who had been treated with radiation for a lymphoma, diagnosed in 1976. Pertinent data show that he was 28 years old and received 140 mrem of cumulative gamma radiation during 1957, and the latent period was 19 years. At the present time, we have been unable to document the total amount of radiation given for treatment of his lymphoma.

When cancer frequency was analyzed by unit, some had slightly more cancer cases than expected, but none of these increases were statistically significant. The largest increases occurred in the smaller units, often with fewer than 100 personnel.

Mortality

This cohort had considerably fewer total deaths (Table 5) than expected from the mortality rates for all United States males. Increases in the number of deaths occur in only three categories—infectious and parasitic diseases, accidents, and killed in action.

Only in this latter category is the increase statistically significant ($P<.0001$). If these test participants remained in the military, this result might be anticipated, but it is difficult to calculate a more precise expected number for the killed-in-action category, since we cannot

Table 4.—Frequency and Death From Neoplasms Among Smoky Participants, 1957 Through 1979

	ICDA* Codes	No. of Cases			99% Poisson Confidence Limits of O/E	No. of Deaths			95% Poisson Confidence Limits of O/E
		Expected	Observed	O/E†		Expected	Observed	O/E	
All neoplasms	140-172, 174-207, 230-239	117.5	112	0.95	0.79-1.14	64.3	64	1.00	0.76-1.28
Buccal cavity and pharynx	140-149	7.9	9	1.14	0.52-2.16	2.2	1	0.46	0.01-2.53
Digestive system	150-159	27.4	19	0.69	0.42-1.08	15.6	15	0.96	0.53-1.58
Respiratory system	160-163	31.2	26	0.83	0.54-1.22	22.3	21	0.94	0.58-1.39
Bones and joints	170	0.5	0	0.00	0.00-7.38	0.4	0	0.00	0.00-9.22
Soft tissue	171	[illegible]	0	0.00	0.00-2.[illegible]	0.4	0	0.00	0.00-9.22
Melanoma of skin	172	3.9	7	1.79	0.72-3.70	1.5	3	2.00	0.41-5.84
Breast	174	0.3	1	3.33	0.08-18.57	0.1	0	0.00	0.00-36.89
Genital system	185-187	12.1	11	0.91	0.45-1.63	2.9	4	1.38	0.38-3.53
Urinary system	188-189	10.2	4	0.39	0.11-1.00	2.6	1	0.38	0.01-[illegible]
Eye and orbit	190	0.4	2	5.00	0.61-18.06	0.1	1	10.00	0.25-55.72
Brain and nervous system	191-192	3.6	5	1.39	0.45-3.24	2.9	5	1.72	0.56-4.02
Endocrine system	193	2.1	0	0.00	0.00-1.88	0.1	0	0.00	0.00-36.89
Lymphoma	200-202	7.2	9	1.25	0.59-2.34	4.2	3	0.71	0.15-2.09
Multiple myeloma	203	1.3	0	0.00	0.00-2.84	0.7	0	0.00	0.00-5.27
Leukemia	204-207	4.0	10	2.50	1.20-4.60	3.1	8	2.58	1.11-5.09
All others and unknown site except nonmelanotic skin cancer	195-199, 230-239	3.8	9	2.37	1.08-4.50	5.1	2	0.39	0.11-1.00

*International Classification of Diseases, Adapted, eighth revision.
†O/E indicates observed/expected.

determine how many persons remained in the military after the Smoky event and were at risk for a combat-related death.

Decreased frequency of death was observed from endocrine, from nutritional and circulatory diseases, and from diseases of the respiratory, digestive, and genitourinary tracts. Only the decrease from circulatory diseases was statistically significant ($\chi^2=9.279$; $.01<P<.001$).

Deaths from individual types of cancer (Table 4) show excesses in five groups—skin melanoma, genital system, eye and orbit, brain and nervous system, and leukemia. Only the number of deaths for leukemia is statistically significantly increased ($P<.02$) compared with the expected number of deaths calculated from US male death rates.

Radiation Exposure

The cumulative 1957 gamma radiation exposure for various groups of participants (Table 6) shows generally low exposures, well within the occupational safety limit of 5,000 mrem/yr. Only 14 persons received exposure between 5,000 and 10,500 mrem.

When the mean cumulative gamma radiation exposure was reviewed, the field units had, in general, somewhat higher cumulative gamma radiation exposure readings. The field units (Pathfinders, 82nd Airborne, 12th Infantry, 50.8 Project, 293rd Mounted Police, 232nd Signal and Human Resources Research Organization, George Washington University) were specifically designated to participate in military maneuvers and special exercises. The other support units had lower cumulative gamma radiation exposure but a higher frequency of cancer, an apparent contradiction if radiation were the causal factor.

Table 5.—Causes of Death Among Smoky Participants, 1957 Through 1979

Cause of Death	ICDA*—8 Codes	No. of Deaths		O/E†	95% Poisson Confidence Limits of O/E
		Expected	Observed		
All causes	. . .	364.6	320	0.88	0.79-0.98
Infectious and parasitic	000-136	4.1	5	1.22	0.40-2.85
Neoplasms	140-207	64.3	64	1.00	0.76-1.28
Endocrine and nutritional	240-279	6.7	4	0.60	0.16-1.53
Circulatory	390-458	138.9	103	0.74	0.61-0.91
Respiratory	460-519	16.6	9	0.54	0.21-0.95
Digestive	520-577	23.1	14	0.61	0.33-1.02
Genitourinary	580-629	4.8	1	0.21	0.05-1.51
Accident	800-949, E800-E949, E980-E989	56.4	63	1.12	0.84-1.41
Suicide	E950-E959	16.1	15	0.93	0.52-1.54
Homicide	E960-E978	13.4	13	0.97	0.52-1.66
Killed in action	E990-E999	0.02	12	600.00	310.0-1,048.1

*International Classification of Diseases, Adapted, eighth revision.
†O/E indicates observed/expected.

COMMENT

These data show a statistically significant increase only for leukemia incidence ($P<.01$) and mortality ($P=.02$). These findings are consistent with those reported previously,[1] when only 76% of the participants had been contacted. Furthermore, the additional leukemia case does not change the results previously reported in any major way.[1] Minor changes were made in mean age at exposure, 24.4 *v* 27.3 years; mean age at diagnosis, 41.8 *v* 42.6 years; mean latent period, 14.2 *v* 14.6 years; and mean cumulative gamma radiation exposure, 1,033 *v* 1,030.7 mrem.

Table 6.—Cumulative 1957 Gamma Radiation Exposure for Smoky Participants

Exposure, in mrem	No. of Participants			
	With Skin Cancer Only	With Other Kinds of Cancer	Without Cancer	Total
0	2	7	144	153
1-499	25	72	2,089	2,186
500-999	1	16	480	497
1,000-1,999	0	4	218	222
2,000-2,999	1	2	109	112
3,000-3,999	0	2	13	15
4,000-4,999	0	0	6	6
≥5,000	0	0	14	14
Unknown	1	1	41	43
Total	30	104	3,083	3,217
Mean gamma exposure	250	397	460	456
Median gamma exposure	160	140	182	180

None of the solid tumors that occurred with increased frequency or mortality were statistically significantly increased ($\alpha = .05$). This study's sample size, composition, and follow-up duration are sufficient to rule out a 30% or greater increase in cancer frequency and a 40% or greater increase in cancer mortality with a statistical power of $\geq .80$ and a one-sided significance level of $\leq .05$. For individual cancers, the minimal detectable increases in cancer frequency at this power and significance level range from 50% (respiratory system cancers) to 1,150% (eye and orbit cancers).

The increased frequency of melanoma recalls the increased incidence of melanoma reported in workers at the Lawrence Livermore Laboratory (LLL) in California.[5] Increased incidence of such cancers, however, has *not* been reported in persons exposed to radiation at Hiroshima and Nagasaki in 1945.[6,7] The reported cumulative gamma radiation exposure was much less in this study than in Japan and is likely to be less than in persons occupationally exposed to radiation at LLL. The age at diagnosis of the melanoma cases found in the Smoky nuclear test participants is comparable with the age distribution of melanoma usually found in US males.[8-10]

Data about a number of potentially confounding demographic variables are lacking because such data were not available. Even though the number of melanoma cases is elevated, more information about place of residence,[11] family background,[12] lifestyle,[13] race,[14] and possibly occupation[5] is needed before any firm conclusions can be drawn.

The increased frequency of brain cancer is at odds with the data from Japan,[6,7] where the incidence was low. Although CNS tissue is relatively radioresistant, ionizing radiation may increase the cancer risk.[15] Again, we lack information about other potentially confounding variables such as race, family background, and other etiologically related exposures.[8]

The increases observed in the incidence of other malignant neoplasms are small and not significant. Any consideration of such increases must recognize the decreases found in the frequency of gastrointestinal and respiratory tract cancers. Furthermore, we found no statistically significant increases in cancer frequency by military unit.

Deaths in this group of participants illustrated again the decrease in mortality, primarily from circulatory and respiratory tract diseases, found in previous studies of military personnel.[16] Similar decreases in mortality are not usually found in such populations for neoplastic diseases.[16] Other studies of employed populations both with and without radiation exposure have shown similar patterns for causes of death.[17,18]

Again, only death from leukemia is statistically significantly increased over that expected (Table 4). Although deaths from other cancers (melanoma, cancer of the eye, brain, or genital tract) were higher than expected, they were not statistically significantly increased.

Even though we could not contact 4.5%, or 145, of the participants, we have assumed that they were alive and free of cancer. This assumption may minimize the number of cases or deaths, but we believe it unlikely that all persons not contacted have died or have had cancer or some other ailment. Their cumulative gamma radiation exposure resembled that of the persons we located, and they were not restricted to any specific unit—a situation that would have biased the unit's collective data.

Other biases that affect the study are obvious. The population studied was selected because of a complaint and was identified by film badges held at a specific but remembered event, even though these same persons had contact with other nuclear tests in 1957. In fact, a few participants[1] were involved in other series, but, although their radiation exposure from those series is unknown, they did not have more cancers or deaths than expected. Whether the index case or the Air National Guard pilot should be included or, for that matter, whether the follow-up study should have been done on this group at all are considerations that could lead to a bias in the findings and conclusions. Other points, about other etiologies, small numbers, incomplete exposure data, and an inability to define the cohort completely before beginning the study were touched on in our first report.[1] However, when the follow-up began, we could not identify any other population completely enough even to begin a study. Consequently, although this study may be flawed, it did show the possibility that one nuclear test participant's suspicions of an untoward effect (increased leukemia) had occurred and that additional analytic studies were needed.

The precise radiation exposure of the participants has been controversial because of incomplete exposure data and perceptions of harm engendered by reports of excess cancers in populations with low levels of exposure usually accepted as safe.[19-21] Although the low-level radiation causality aspects of two reports[20,21] have been challenged and to some extent refuted by later studies,[18,22-24] a third report[25] has led to the extensive Off-site Radiation Exposure Review Program by scientists under contract to the Department of Energy. The previous study[1] has also led to the development of a large exposure review project[26,27] and a more analytic follow-up of mortality in nuclear test participants by the National Academy of Sciences.

Finally, although our reasons for undertaking this study in early 1977 were the report of leukemia in one participant and his fear that other unreported cases had occurred, we expected that some sort of an accident was most likely. We did not expect to find only the small exposures recorded on the film badges or to become embroiled in the low-dose controversy. In fact, our follow-up adds little to resolve the exposure-level controversy because of the uncertainty surrounding the claims and counterclaims of the reported exposure data (*Atlanta Constitution*, Feb 8, 1982, pp 1A, 9A; Defense Nuclear Agency Media Advisory 82-1, Feb 12, 1982). In any case, the exposures reported are low, and the studies to review those exposures report only small differences from theoretically calculated exposures but may not entirely account for the possibility of exposures not recorded on the film badges.[26,27] However, these data cannot resolve this question, because of the small number of persons involved, the potential bias of case and group selection, and the possible loss of other cases in the unlocated participants. Further support for the idea that the overall radiation exposures were low (as the military has suggested) results from review of the cancer occurrence and radiation exposure of the individual units. Although some units had an increased cancer frequency, most were not the field units that generally had higher mean cumulative gamma exposures, because the latter spent more time in the fallout fields on the day of detonation. Finally, most of the statistically insignificant cancer increases occurred in 15 of 36 units, with mean cumulative gamma exposures less than the overall mean (456 mrem).

This study shows only an increase in frequency of occurrence of leukemia and death from leukemia that confirms the index case's impression about the Smoky participants. However, the low overall cancer incidence and mortality, the low level of exposure (uncertain as it is), and the lack of correlation between field unit and mean cumulative radiation exposure suggest that this one positive finding may be either attributable to chance or the result of an unknown combination of factors. Furthermore, this conclusion cannot be generalized to include participants at other nuclear tests or resolve the low-dose controversy.

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TESTIMONY BEFORE THE HOUSE COMMITTEE ON VETERANS' EXPOSURE TO IONIZING RADIATION

May 24, 1983

Seymour Jablon

National Academy of Sciences - National Research Council

24 May 1983

Mr. Chairman and Members of the Committee:

I am very glad to have the opportunity to appear before you. I have been asked to tell you about what is known concerning the health effects on humans from low levels of ionizing radiation.

I am a member of the staff of the National Academy of Sciences and Director of the Medical Follow-up Agency. I have spent six years in Japan participating in the follow-up studies of the survivors of the atomic bombing of Hiroshima and Nagasaki. I am now the Academy's staff officer for the continuing program in Japan. I am, however, testifying today as an individual and not on behalf of the Academy. A curriculum vitae is attached to this testimony.

Much of what I will say has been drawn from the 1980 report of the Academy entitled "The Effects on Populations of Exposure to Low Levels of Ionizing Radiations", which was prepared by the Committee on the Biological Effects of Ionizing Radiation. This is referred to briefly as BEIR 1980.

A great many epidemiological studies have been completed, and several others are under way right now. Most are referenced in the BEIR report. I will limit myself to an attempt to summarize what is now known, and mention the uncertainties in our knowledge.

Radiation in large doses of hundreds to thousands of rads, as might be given as therapy to a patient suffering from a radiation-sensitive cancer, causes characteristic tissue damage which becomes apparent within days. These kinds of injury, which have been called "organ effects", are not what you are concerned with here. You are interested, I believe, in the effects of low levels of radiation, doses below, say, ten rads, and which are sometimes received over a protracted period of time at what is called a low "dose rate". Such doses may come from diagnostic X-rays used by physicians, from occupational exposures or natural background. Such doses can cause injury, but the injuries, which are sometimes called "stochastic effects," differ in important ways from the organ effects produced by large doses:

o The effects are principally the induction of malignant neoplasms - cancers - which are indistinguishable from those which arise "naturally" i.e., from unknown causes. Given that a person has, say, acute leukemia and a history of exposure to ionizing radiation, it is impossible to be certain that the leukemia was caused by the radiation; it might, perhaps, have occurred even had there been no radiation. All that can be known for certain is that the leukemia might have been caused by the radiation, and the larger the radiation dose, the greater the chance that it was.

o It is believed that when cancers are induced by ionizing radiation, the initial injury consists of damage to a single cell, or at most to a few adjacent cells. Further, the injury must be of a very particular kind, and not, for one reason or another, be repaired by the repair mechanisms which cells possess. Probably additional changes (called "promotion") are required following the initial transformation caused by the radiation. These changes are not well understood, but it is clear that they often occur only after a long delay. After they occur, if they do, more time is needed during which the cancerous focus increases in size by cell division. The net result is that it may take many years for the original radiation injury to manifest itself as an observable malignant neoplasm. Thus, radiation-induced leukemias almost never occur short of two years following the radiation, and may be delayed for fifteen or twenty years. The so-called solid tumors, like lung cancer or stomach cancer, usually require at least ten years to become evident and may be delayed for twenty, thirty or forty years.

The consequence of these characteristics of the adverse health effects of low-dose radiation is that their study and characterization has been very difficult. It has been necessary to study very large groups of persons who received known radiation dose, and to follow the study groups for long periods of time - several decades. It is not, therefore, surprising that most of what we know about cancer induction by ionizing radiation - what is called "radiation carcinogenesis" - derives from a relatively few, well-studied, population groups. These include:

o Japanese survivors of the atomic bombings of Hiroshima and Nagasaki.

o Miners of uranium and other ores who work in atmospheres rich in radon, a radioactive element.

o Persons occupationally exposed in manufacturing and production activities involving uranium or plutonium. Most of the exposures have been at various national laboratories.

o Patients who have, for one reason or another, received many X-ray examinations, such as fluorographic studies of the chest while monitoring the treatment of tuberculosis. Quite substantial doses can be accumulated under these circumstances.

o Patients who have received radiation doses from radiopharmaceutical products in the course of diagnostic procedures or from X-ray primarily directed elsewhere. For example, X-ray was at one time the treatment of choice for ringworm of the scalp; in the course of such treatment, however, the thyroid glands of the patients received enough radiation to cause an increase in the rate of thyroid cancer.

Because of the need to study exposed population over very long periods of time most studies have relied on death certificates to document increases in cancer mortality rates. Death is, of course, a matter of public record and, in almost all states cause of death can be ascertained. To study illness over several decades in a population of several thousand persons is an almost prohibitively expensive undertaking. Even in Japan, although the mortality study of the atomic bomb survivors includes nearly 110,000 persons, for logistic reasons the medical examination program had to be limited to 20,000, less than one-fifth of the total number.

A dose of 600 rads or more delivered within a short time will usually cause death within a few days. The adverse effects which follow lower doses have been pretty well identified:

1. Cancers. Most forms of cancer can be induced by radiation, but probably not all of them. Thus, one particular type of leukemia, chronic lymphatic leukemia, is apparently not induced by radiation and for some other sites the risks appear

to be quite low. The cancers which are induced by radiation include, besides leukemia, cancers of the lungs, the female breast, the thyroid gland, the stomach, colon, liver, pancreas, kidney and bladder, and esophagus. BEIR 1980 provides specific risk estimates for all of these.

2. Impairment of growth and development in children who are exposed to high doses - 50 rads or more.

3. Induction of opacities, including cataracts, in the lens of the eye.

4. Genetic effects: Radiation-induced mutations in germinal cells, which may then manifest themselves in offspring as detectable mutations.

All four kinds of effects can be, and have been, produced experimentally in laboratory animals.

It should be understood clearly that the effects that have been demonstrated unequivocally have been seen only at doses much larger than those which you are chiefly concerned with. The smallest dose which has been shown to induce cancers in humans is about six rads to the thyroid gland in Israeli children treated for ringworm. For radiation protection purposes it is usually assumed that effects which are seen at higher doses can also be produced by lower doses, with the frequency of occurrence reduced in proportion to the size of the dose. Some radiobiologists believe that the reduction is even greater than proportional, but there is no direct evidence, in man, for this point of view and, in my opinion, prudence dictates that we should not assume a reduced effect that has not been proved.

Concerning genetic effects, there is no question, on the basis of experimental results in mice and fruit flies, that radiation causes genetic damage, and there is no reason to think that man is different in this respect from the laboratory mouse. However, it seems plain that the rate at which these effects occur is low. It has not been possible to identify excessive numbers of children with congenital abnormalities even among the offspring of Japanese atomic bomb survivors. The reason for this, presumably, is not that they do not occur, but that the proportion, in any population, of children born with these abnormalities, is, unfortunately, large enough (nearly five percent) that the few additional, radiation-induced cases, cannot be seen. It seems certain that if genetic effects cannot be identified among the atomic bomb survivors, it will not be possible to identify them in the offspring of veterans whose doses were very much smaller.

Although the evidence is clear that radiation does cause cancer, it is necessary to put this fact into context numerically. What risk does an individual, or a group of persons, face, following a radiation exposure? The BEIR 1980 report provides several possible estimates of the effects at low doses. The reason for this multiplicity of estimates is that the risks are observable and measurable only at fairly high doses (50 rads or more) and there is no firm consensus on the proper way to project to low dose risks that have been measured at high dose levels. The largest estimate obtainable from the several models presented in BEIR 1980 is that a one rad dose to a population of one million persons would result in about 500 extra cancer deaths during that population's remaining lifetime. The uncertainty in that number is such that it might well be less than 100.

There is one additional element of uncertainty in the risk estimates that should be mentioned. Although the BEIR 1980 risk estimates are based upon the results of many studies, the most important, in terms of the size of the population and the magnitude of the doses received, is the study of the survivors in Hiroshima and Nagasaki: There were more than 25,000 survivors who had doses estimated to exceed ten rads and the average dose was more than 80 rads. Within the past two years new, refined computations have indicated that the doses may have been over-estimated. An intensive effort is being made to revise the dose estimates in the light of present knowledge and calculational ability. That effort will not come to fruition for several months but, at this time, a preliminary guess is that new estimates of the doses could be about one-half of the previous estimates and, hence, the radiation risk estimates may be doubled.

To put this into context, how much is one rad?

o The background radiation to which we are all exposed amounts to about one-tenth of a rad per year. This comes principally from cosmic rays, from naturally occurring radionuclides in some rocks and from potassium 40, a primordial radionuclide, with smaller amounts from other sources, including the residuals of global fallout from atmospheric weapons tests. One rad, then, is about ten years' worth of average background radiation.

o An X-ray of the chest, as might be done for the diagnosis of tuberculosis, today delivers about one-twentieth of a rad. Forty years ago, when the possible dangers of radiation were not fully appreciated, doses were much larger: In 1942 and

1943, Army induction stations employed a procedure for tuberculosis screening that delivered at least one rad to the thorax of every person inducted; equivalent doses were given by the itinerant X-ray screening vans that, during the late 1940's, roamed the cities in an ultimately successful war on tuberculosis.

So much for what a rad is. To put into context the risk imposed by one rad, a population of one million persons will ultimately suffer about 160,000 deaths from all forms of cancer at current U. S. mortality rates. The 500 extra cancer deaths that might be imposed by a whole body dose of one rad amounts to less than a one-third of one percent increase in the cancer death rate.

If we were to perform an imaginary experiment, by taking two equivalent populations of one million persons each, and gave each person in one of the groups one rad of whole-body radiation, then followed both populations for sixty or seventy years counting each cancer death that occurred in each, at the end of that time the excess of cancer deaths in the exposed population might be detectable - barely - in the face of normal statistical variability. In a word, it is a practical impossibility to demonstrate in a human study, the carcinogenic effects of radiation at the level of one rad, or even five rads.

This Committee is especially interested, I know, in the problems that are being brought to their attention by veterans who participated in tests of nuclear weapons in Nevada or at the Pacific Test Area twenty or more years ago. Dr. Glyn Caldwell of the Center for Disease Control, had his attention drawn to Shot SMOKY because a veteran who had attended that test in 1957 later developed leukemia. Dr. Caldwell traced as many as possible of the former SMOKY participants, and identified eight additional cases of leukemia. At normal rates for leukemia, only 3.5 cases would be expected to occur in the group of just over 3,000 men; the number that occurred, nearly three times the expected number was too large to be easily explained as a mere sampling discrepancy.

The nuclear test series participants are now more than forty years of age, that is, have reached the age when cancers begin to take their toll. I remind you that, at normal population rates, some sixteen percent of all of the participants will die of cancer. The result is easily imagined: Large numbers of veterans who had participated in the tests and who subsequently developed cancer or any other rare and obscure degenerative disease began to suspect that their illnesses resulted from radiation exposures received while in military service. The nuclear test participants were quickly joined by other veterans who had served as occupation troops in Nagasaki or, they claimed, Hiroshima.

The National Academy of Sciences in the BEIR 1980 report, had stated, on the basis of many studies, that the leukemogenic effect of radiation was perhaps 2.2 cases per million persons per year per rad. The Defense Nuclear Agency (DNA) asserted that film badge dosimetry disclosed that the average dose to SMOKY participants was less than half a rad; in twenty years subsequent to the SMOKY Shot only about 30,000 person-year-rads had accumulated, so the expected excess leukemia caused by SMOKY radiation was about a tenth of a case. But nearly six excess cases had been found. What was wrong? There seemed to us to be three principal alternative explanations:

1. The BEIR 1980 risk estimates are wrong, by more than a factor of ten.

2. The doses recorded by film badges for the participants were far lower than those the men actually received. Such a result could follow from overlooking exposures to neutrons (to which the film badges did not respond) and to possible inhaled or ingested radionuclides, to which, equally, the film badges would not respond.

3. Dr. Caldwell's result represented a chance event, unlikely, but possible.

The National Research Council undertook studies on a larger scale than Dr. Caldwell's study in an effort to distinguish among these possibilities. These studies are of deaths that have occurred among some 55,000 participants in test series PLUMBBOB or UPSHOT-KNOTHOLE in Nevada or in CASTLE, REDWING or GREENHOUSE at the Pacific Test Area. SMOKY was, of course, one shot in the PLUMBBOB series. This work has not yet been completed but I can summarize quickly in a preliminary and unofficial manner the most important facts:

- As to SMOKY, our results essentially duplicate Dr. Caldwell's findings.
- With respect to the other 52,000 participants at other Shots in the PLUMBBOB series, or UPSHOT-KNOTHOLE, GREENHOUSE, CASTLE or REDWING, no excess of deaths from leukemia or from other forms of cancer, or from other diseases has been found.

Where does this leave us? We can be satisfied that the BEIR risk estimates are not so far wrong as might have been conjectured originally. That leaves two possibilities: The doses at SMOKY were larger than had been supposed, or SMOKY was a chance aberration. I am not an expert in dosimetry, and leave to those who are to testify as to this possibility. I can say, however, that reports I have seen which were produced by Science Applications Incorporated, contractors to DNA, leave the clear impression that the film badges of at least one group at SMOKY, called Task Force WARRIOR, measured only one-half of an estimated mid-line dose from external radiation. In addition, there is the possibility of inhalation or of ingestion of radionuclides. If, however, erroneous dosimetry is the explanation of the SMOKY finding, there remains the question of why and in what way was SMOKY different from all of the other shots that we studied? SMOKY was, in fact, not a typical shot in some ways: It had a fairly high yield - 44 kilotons - and was fired from a steel tower. It was, by a small margin, the most powerful device fired from a tower at the Nevada Test Site.

We cannot say with any assurance why the SMOKY participants have apparently suffered from an excess occurrence of leukemia. It would appear, however, that participants at other tests, in Nevada or the Pacific Test Area, have not been exposed to a detectable excess risk.

I will add just a word concerning occupation forces in Nagasaki or Hiroshima. There we are on somewhat firmer ground: The occupation forces did not arrive until several weeks after the detonations. Residual radiation was measured by both Japanese and American scientists and, at the time the troops arrived the levels were so low that no member of the occupation forces could have received doses more than one-tenth of a rad - about one year's worth of background radiation. And this is an upper limit - most of the troops would have had much lower doses. Further, thousands of Japanese entered the two cities within hours and days of the explosions - long before the occupation troops. The studies conducted by the Atomic Bomb Casualty Commission and its successor, the Radiation Effects Research Foundation, have failed to find any evidence of health effects in these Japanese "early entrants".

In summary, it can be said with some assurance that, on the basis of known science, a few cancers may have been produced in veterans who were exposed to ionizing radiation while in service - whether from bomb tests, or X-ray examinations, or residual radiation in Nagasaki - but such cancers would represent only a tiny fraction of the cancers that these men have already suffered or, unfortunately, will suffer from in future years. And there is no way to distinguish, reliably, between any that were, in fact, induced, and the many others.

Curriculum Vitae

Name: Seymour Jablon

Date of birth: 2 June 1918

Place of birth: New York, New York

Education:
College of City of New York, B.S., Cum Laude, 1939
Columbia University, M.A. (Mathematics), 1940
Columbia University, Graduate Study in Mathematics, Mathematical Statistics, 1940-41, 1947-48.

Military Service: Army of United States, 1942-46.

Positions:

Statistician, New York State Department of Labor, Albany, 1941-42.

Statistician, U. S. Bureau of Labor Statistics, 1942, 1946-47.

Instructor, Rutgers University, New Jersey, 1947-48.

Professional Associate, Division of Medical Sciences, National Academy of Sciences-National Research Council, 1948-60.

Chief, Statistics Department, Atomic Bomb Casualty Commission, Hiroshima, Japan, 1960-63, 1968-71.

Associate Director, Medical Follow-up Agency, National Academy of Sciences-National Research Council, 1963-68, 1971-1977.

Director, Medical Follow-up Agency, National Academy of Sciences-National Research Council, 1977-

Member:

Clinical Trials Review Committee, National Heart and Lung Institute, 1971-1975.

Biometry and Epidemiology Contract Review Committee, National Cancer Institute, 1967-68, 1971-72.

Clinical Research Contracts Advisory Committee, Food and Drug Administration, 1967-68.

Consultant to Subcommittee on Somatic Effects, Committee on Biological Effects of Ionizing Radiation, National Academy of Sciences-National Research Council, 1971-72.

Member: (continued)

National Council on Radiation Protection and Measurements, 1974-

Chairman, NCRP Committee 59, Evaluation of Human Radiation Exposure Experience, 1979-

Member, NCRP Scientific Committee 1, Basic Radiation Protection Criteria, 1980-

Member, NCRP Scientific Committee 71 on Radiation Exposure and Potentially Related Injury, 1981-

Board of Scientific Counselors, Division of Cancer Cause and Prevention, National Cancer Institute, 1978-1981

Dose Assessment Advisory Group, Department of Energy, 1980-

Armed Forces Epidemiological Board, 1982-

Society Membership: American Epidemiological Society (Emeritus)

American Statistical Association (Fellow)

Biometric Society

American Association for the Advancement of Science

Radiation Research Society

Society for Epidemiologic Research

Health Physics Society

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NAAV

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TESTIMONY OF JOHN SMITHERMAN
PRESIDENT

NATIONAL ASSOCIATION OF ATOMIC VETERANS

BEFORE THE HOUSE
VETERANS AFFAIRS COMMITTEE

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

We wish to thank you for the invitation to present this testimony on behalf of those Veterans who, while in the service of their country, were exposed to ionizing radiation from atomic and thermonuclear weapons detonations and who now suffer because of that exposure.

The National Association of Atomic Veterans (NAAV) is a nation-wide membership organization comprised of those veterans who participated in atmospheric nuclear weapons tests between 1945 and 1962, as well as those who served in the U.S. occupation of Hiroshima and Nagasaki immediately following World War II. Many of these veterans now suffer from various radiation-related illnesses. However, less than 1% of their claims for service-connected disability benefits have been approved as radiation-related by the V.A.

Years of neglect, misdiagnosis, poor treatment, lost and misplaced service and medical records, denial of claims, callous stonewalling--all of this has been the experience of the Atomic Veteran at the hands of their government. The only conclusion many Atomic Veterans are left with is that a government-approved suppression of the facts about the nuclear weapons tests has been passed from one Administration to the next. The Department of Defense, which ordered the men to be exposed, and the Veterans Administration, which is supposed to provide treatment, are seen as using their influence to avoid the obligation owed to the victims of nuclear weapons radiation exposure.

WITHOUT CONSTITUTIONAL RIGHTS, THERE CAN BE NO JUSTICE

> "In some instances the objectives of an unfettered military must take precedence over the rights of individual citizens."
>
> Betty Laswell v. Harold Brown et al,
> U.S. Court of Appeals, Eighth Circuit,
> No. 81-1768 (July 21, 1982)

Known as the "Feres Doctrine", this language has been used repeatedly by the courts to deny the constitutional rights of Atomic Veterans, their wives and widows, and their children. A perversion of the Congressional intent underlying the Federal Tort Claims Act, the "Feres Doctrine" has left the military victims of the Cold War with no relief other than that promised but not forthcoming from the Veterans Administration. It has left the genetically effected children with nothing.

SUMMARY OF COMMENTS

The main concerns to be addressed by NAAV in this testimony include:

1) The need for creation of a legislative presumption of service-connection for all disability claims filed by Atomic Veterans suffering from cancers;

2) The need for epidemiological studies to determine statistically whether Atomic Veterans are suffering an increased incidence of various non-malignant diseases which may be attributable to radiation exposure;

3) The need, while the epidemiological studies of the veterans are being conducted, to afford to all Atomic Veterans hospital care and medical services on a priority level equivalent to that afforded any veteran with a service-connected disability which has been rated at 50 percentum or more;

4) The need to initiate immediate and comprehensive epidemiological studies of the children of Atomic Veterans to determine whether they are suffering an increased incidence of serious health and genetic problems that may be associated with their fathers' exposures;

5) The need to establish an Advisory Committee on Atomic Veterans; and

6) The need for the Veterans Administration to locate and apprise all Atomic Veterans of the V.A. health care services which have recently been made available to them, pursuant to the V.A.'s legislative mandate found at 38 U.S.C. S241.

I. A LEGISLATIVE PRESUMPTION OF SERVICE-CONNECTION FOR CANCERS AMONG ATOMIC VETERANS IS NEEDED

The Defense Nuclear Agency concedes that the vast majority of Atomic Veterans were exposed to ionizing radiation. It and the Veterans Administration argue, however, that such exposures were too low to cause the cancers and other health problems now being suffered by Atomic Veterans. Despite the fact that it has become almost universally recognized that exposure to even small doses of ionizing radiation increases the risk of developing cancer later in life for those exposed, the DNA and the VA cling to the archaic notion that there is an exposure level (or "threshold") below which risk to human life does not occur.

Having chisled in stone an anachronistic scientific myth, the V.A. would also have this Committee believe that every reasonable doubt is decided in the Atomic Veteran's favor, and that his disability claim will be awarded when "reasonable probability" has been established. For those who, as Atomic Veterans, have experienced first hand the V.A. claims process, this V.A. pretense defies polite response.

The truth of the matter is that the V.A. forces upon the Atomic Veteran a burden of proof no court would require. He is asked to establish his presence at a nuclear test detonation by production of military personnel records which were either never kept, have been lost, or which were destroyed in a fire at the military records center in St. Louis during the early '70's. He is asked to establish proof of exposure based again upon records which can never be found, or when found, are grossly incomplete. He is asked to prove that his disease or illness has been caused by the radiation exposure he cannot document. Finally, he is denied access to the Defense Department records which are used against him during the disability claims process. (See Appendix B,"Request for Records")

Standards for claims adjudication would definitely help, and a request for their adoption seems reasonable. Yet the V.A. has refused to adopt such standards with a passion. Four years ago the Interagency Task Force on the Health Effects of Ionizing Radiation recommended that the V.A. develop comprehensive standards for radiation-related claims. Today there still are no V.A. standards, despite requests by Congressmen, despite pleas by veterans' groups' despite lawsuits and Judge's orders.[1] For the Atomic Veteran pursuing a scientifically complex case (even were all relevant facts obtainable), the V.A. claims process becomes a personal commitment to years of administrative chaos and personal frustration.

Broad-based epidemiological studies of the relative incidence of cancers and other diseases would be most beneficial. The results of such studies would serve as a basis for determining whether specific diseases among Atomic Veterans were, within "reasonable probability," radiation-related, and thereby service-connected. Yet the V.A. fights such studies with a passion only surpassed by the Defense Department's passion for avoiding the truth. Unceremoniously, Atomic Veterans are being asked to die without recognition while the scientific debate over the health effects of radiation exposure rages.

What is the Defense Nuclear Agency's role in this funeral procession?

The Defense Department, which was charged with protecting the men at the test sites, recording accurately radiation exposures received, and preserving personnel, exposure and medical records, has failed in its responsibility at every step and with every turn. Its "mea culpa," twenty and thirty years and untold deaths later, is to "reconstruct" the events of each test and the exposures to which the unwitting veterans were callously subjected.

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[1] See Gott v. Nimmo, Nos. 82-1159,-1448,-1454 (D.C. Cir.).

The result of the Defense Department's multi-million dollar "reconstruction" has been the production of documents that leave the reader with the distinct impression that there is more risk to human life in a Sunday afternoon picnic in the park than there was for the men who were present at Ground Zero. Conveniently, the Defense Department controlled the documents upon which test "reconstruction" was based. No one, and especially not the veterans whose health and lives are critically at stake, has ever been allowed to obtain or review the "declassified" documents which have served as the basis for the Defense Department's reports.

At least this was the case up until today, and this Committee's review of the declassified documents of "Operation Crossroads" which were discovered by the National Association of Atomic Veterans in a public library on the UCLA campus. These documents should give even the strongest supporters of the V.A. and the Defense Department serious cause for concern. They unequivocally demonstrate that the health and the lives of the veterans of nuclear testing were placed at severe risk by weapons beyond the control of the best of America's scientists.

It is too late for Atomic Veterans, and would prove too costly for our government, to force the Defense Department to return to the drawing board of "reconstruction" in search of facts that more closely resemble the truth of the atmospheric nuclear weapons testing period. The only reasonable thing to do, and the only fair thing to do, is to resolve all questions of doubt in favor of the Atomic Veteran, and to do so as expeditiously as humanly possible.

Atomic Veterans identified by NAAV are suffering from a very high incidence of cancers and certain non-malignant disorders. With respect to all cancers suffered by Atomic Veterans, NAAV seeks from this Committee, and from this Congress, legislation which would provide a presumption of service connection. It is recognized that similar legislation is being considered by this Congress for Vietnam era veterans exposed to toxic herbicides. Such consideration for these patriotic young men is well deserved. So too is such consideration deserved by Atomic Veterans. Thousands of studies have been undertaken and completed associating exposure to radiation with an increased risk of later contracting cancer. Moreover, the few epidemiological studies of Atomic Veterans that have been undertaken, in this country and in England, have unquestionably established a statistically significant increase in leukemia and other identifiable cancers. Basic fairness mandates that the burden of proof in these situations be legislatively removed from the veteran or his widow, and placed squarely upon those responsible for subjecting these men without warning (either at the time of the test or since) to the hazards of nuclear warfare. Ultimately, it is a question of who should bear the burden and pay the price of nuclear deterrence -- the victims? or the society whose freedom was guaranteed through the sacrifices made by a quarter of a million patriotic men.

II. STATISTICAL HEALTH STUDIES WOULD DETERMINE WHETHER THE VETERANS SUFFER FROM RADIATION-RELATED DISEASES IN ADDITION TO CANCERS

Among Atomic Veterans contacted by the National Association of Atomic Veterans, an alarmingly high incidence of non-maligant disorders can be associated with exposure to low level radiation.

However, should it be the case that Atomic Veterans were exposed to high levels of radiation, then even the Defense Nuclear Agency concedes the real possibility of their causation being radiation. General Friffith, before the Senate Veterans Affairs Committee on April 6th, stated in his prepared remarks: "It has been demonstrated that exposures to high levels of radiation, in excess of 100 rem, may lead to adverse long term health effects: cataracts, premature aging, impaired fertility. . ." In fact it may actually be the case that Atomic Veterans were exposed to such high levels of radiation! (See testimony of Dr. Arjun Makhijani, and attached documents pertaining to Operation Crossroads.) If such exposures prove to be the case, then the arguments made by NAAV in support of the establishment of a presumption of service-connection for disability claims involving cancer will apply as well to these other non-malignant diseases.

While we await further investigation of radiation exposure levels, however, statistical studies can and should be undertaken to determine whether the non-malignant health problems of Atomic Veterans can be presumed to have been caused by radiation exposure epidemiological studies are needed. These studies would determine, based upon a statistical analysis, whether Atomic Veterans are suffering from various diseases at a rate higher then the general population.

Senator Alan Cranston, ranking minority member of the Senate Veterans Affairs Committee, has introduced Senate Bill S. 11. This bill would require the initiation of these needed epidemiological studies. At the recent Senate Veterans Affairs hearing of April 6th, however, the V.A. voiced strong opposition to this bill and the need for the studies. The V.A. argued that to conduct such studies would be a waste of taxpayers' money, supporting their argument by citation to experts who believe the radiation to which the veterans were exposed could not cause the high incidence of non-maligant disorders they are now suffering.

Not to conduct such studies might prove a waste of human life. This the Committee must balance against the V.A.'s argument for preserving the pocketbook. Moreover, for every expert the V.A. presents stating radiation does not cause heart disease or degenerative bone and muscle disorders, NAAV can provide its own expert who says that radiation does cause these problems. (See testimony of Dr. Edward Martell).

The point is that an epidemiological study would quickly establish whether there is a statistically significant increase in certain diseases among Atomic Veterans. This would be all that would be needed for purposes of V.A. claims adjudication. We know that the method works. It has been proven effective in establishing the relationship between heart disease and limb amputation among veterans. It has been authorized for the

Vietnam era veterans exposed to herbicides. Atomic Veterans deserve at least this much.

III. HEALTH CARE

Public Law 97-72 does not afford Atomic Veterans the type of priority health care treatment they need and deserve. It did not do so prior to the recent adoption of new V.A. guidelines implementing this law. (See Appendix "B") Preliminary results of a recently initiated NAAV monitoring program of the new guidelines indicate that Atomic Veterans are still being refused V.A. hospital services and needed medical care.

Until a comprehensive epidemiological study can be completed, which would answer many of the questions yet unresolved, NAAV strongly recommends that health care and treatment be provided all Atomic Veterans on a presumptive basis similar to that afforded veterans suffering from psychosis. (See 38 U.S.C. S 602) Providing Atomic Veterans hospital care and medical treatment at a priority level equal to any veteran who has a service-connected disability rated at 50% or more would insure that while the health studies are done, no one deserving of care would be turned away. It would also insure that the V.A. foot-dragging that has accompanied the Agent Orange health study will not occur with the Atomic Veterans.

IV. STATISTICAL HEALTH STUDIES OF THE GENETIC PROBLEMS AMONG VETERANS' CHILDREN ARE ESSENTIAL

Serious health and genetic problems among children and grandchildren have been reported by the Atomic Veterans polled by NAAV. For example, in one NAAV survey of approximately 1000 Atomic Veterans, 50% of those responding reported children with serious health and genetic problems. These problems include cancers, mental retardation, cerebral palsy, etc.

In addition to health studies of Atomic Veterans, Senate Bill S. 11 would require the Veterans Administration to contract with an independent third party to study the incidence of these and other health and genetic problems among the offspring of Atomic Veterans. As with all other studies designed to get to the truth of what has happened in the aftermath of atomspheric nuclear testing, the V.A. opposes this study. They argue that there is no evidence of genetic problems being caused by the father's exposure to radiation, and therefore no need to conduct the studies called for in S. 11 to determine whether any problems have been caused. The illogic of this argument is so absurdly obvious no comment is needed.

Yet, as if they have recognized, themselves, the weakness of their first argument, the V.A. tried again before the Senate Veterans Affairs Committee in April. The V.A., rather cruelly, argued that no studies of the children should be done because to do so would create unnecessary anxiety and "needless suspicions and fears."

Should the V.A. and those with its offices who pride themselves in their compassion not realize it, Atomic Veterans, their wives and widows, are already suffering from anxiety and fear. What frighteningly appears to be happening to many of their children is of far greater concern to them than that which afflicts the veterans themselves. Health studies of the children will serve to reduce the anxieties of tortured parents, despite the V.A.'s wisdom to the contrary. The results of those studies will help to define what obligations, if any, are owed by our government to the innocent.

Because the same urgency and many of the same needs and long-term concerns are present in the resolution of problems associated with Atomic Veterans, NAAV strongly recommends the creation of an Advisory Committee on Atomic Veterans similar to that created under 38 USC 221 for former Prisoners of War. In this manner, we can assure that Atomic Veterans and veterans' service organizations representing Atomic Veterans will be involved in a meaningful manner in addressing the issues which must be addressed and resolved over the next several years related to this matter.

VI. 250,000 ATOMIC VETERANS MUST BE LOCATED AND WARNED

38 U.S.C. 241 establishes a mandate that the V.A. notify eligible veterans of "benefits and services to which they may be entitled under laws administered by the Veterans' Administration." On April 6, 1983, the V.A. Adminsitrator signed into effect guidelines making certain medical care and treatment available to virtually all Atomic Veterans. NAAV requests that the V.A. distribute, at least to the 50,000 Atomic Veterans known to the Defense Nuclear Agency, copies of the recently signed guidelnes along with a summary of what the new guidelines mean for these veterans.

The V.A. may argue in opposition to this request that the Defense Nuclear Agency has in the past informed these veterans of their eligibility for free medical examination at any V.A. hospital. However, lest this Committee be persuaded by this argument, it should be pointed out that prior to the V.A.'s April 6th action, Atomic

Veterans were not eligible for treatment under Public Law 97-72 unless they had cancer. The V.A.'s interpretation of PL 97-72 has changed, affecting the rights thereunder of many Atomic Veterans. They need to be apprised of this important development. The V.A. is under a Congressional mandate to see that they are so apprised.

CONCLUSION

On behalf of their country, Atomic Veterans were present at "Trinity," the first atomic bomb test. They were at Hiroshima and Nagasaki, Japan. They were present for seventeen years at the Nevada and Pacific nuclear testing sites. They patriotically served their Country and met the needs of National Defense during a very critical period of history. Atomic Veterans are now being condemned to illness and slow, painful death. Worse, they are witnessing in their children serious health and genetic problems for which there is absolutely no present possibility of relief.

Recognition of the patriotic service Atomic Veterans rendered for their Country, and relief for the consequences of that service, is why the National Association of Atomic Veterans is here today. We thank you for this opportunity to present our views.

APPENDIX "A"

NAAV HEALTH SURVEY, 1982

-- 1200 questionaires sent out
-- responses received from 700
-- age group-- between 40 and 55

DISEASE REPORTED	INCIDENCE
All cancers	39%
Muscle disorders	67%
Bone disorders	45%
Joint disorders	56%
Internal (total)	44%
Blood/urine	9%
Blood/rectal	24%
Heart (total)	45%
High blood pressure	30%
Heart attack	13%
Hardening of arteries	10%
Emotional problems	64%
Non-malignant rash	33%
Lung disorders	49%
Numbness in extremities	55%
Headaches	33%
Loss of hearing	33%
Tinnitus	34%
Sterility	11%

SERIOUS HEALTH AND GENETIC PROBLEMS REPORTED IN OFFSPRING:

2nd Generation	50%
Miscarriages	30%

APPENDIX "B"

PRELIMINARY RESULTS OF NAAV QUESTIONAIRE TO MEMBERS ON WHETHER V.A. HEALTH CARE IS BEING PROVIDED AND WHETHER CLAIMS PROCESS IS WORKING

-- questionaire sent to 2,000 members
-- date of study- Jan/Feb, 1983
-- responses reviewed to date- 400
(except where noted otherwise)

V.A. Health Care:

Atomic Veterans receiving physicals or treatment under Public Law 97-72	20%
Atomic Veterans receiving V.A. treatment for all problems (non-radiation related)	60%
Atomic Veterans satisfied with V.A. health care	39%
Atomic Veterans dissatisfied with V.A. care	61%
Atomic Veterans denied V.A. treatment	27%

Out of 700 responses reviewed:	Total number (not a percentage)
Atomic Veterans with cancer who have been denied V.A. health care. . . .	20

Disability claims filed with V.A. for service-connection:

Out of 700 responses reviewed:	Total number (not a percentage)
(1) Claims filed where Veteran had cancer and where doctor stated probability of cancer being radiation-related . . .	22
No. of cancer claims awarded	1
No. of cancer claims denied	21
(2) Claims filed for non-malignant disorders where doctor stated probability of disease being radiation related	28
No. of non-cancer claims awarded	0
No. of non-cancer claims denied	28
(3) Total number of cancer claims filed . . .	107
No. of cancer claims awarded	4
No. of cancer claims denied	83
No. of cancer claims pending	20
(4) Leukemia claims	
Total number of leukemia claims reported .	16
No. of leukemia claims awarded	2
No. of leukemia claims denied	14

(cont)

APPENDIX "B"

(All tabulations and figures based upon 400 responses from NAAV members.)

REQUESTS FOR RECORDS--

Number of Atomic Veterans requesting military service records	144
Percent of Veterans receiving complete military service records	15%
Percent of Veterans not receiving records. (or records incomplete)	85%
Number of Atomic Veterans requesting military medical records	127
Percent of Veterans receiving complete military medical records	13%
Percent of Veterans not receiving medical records (or records incomplete)	87%
Number of Atomic Veterans requesting medical records from V.A.	130
Percent of Veterans receiving records . .	52%
Percent receiving incomplete records	5%
Percent not receiving med. records	43%

IRRADIATION OF PERSONNEL DURING OPERATION CROSSROADS:

AN EVALUATION BASED ON OFFICIAL DOCUMENTS

BY

DR. ARJUN MAKHIJANI AND DAVID ALBRIGHT

MAY 1983

for presentation by

DR. KARL Z. MORGAN

before

THE HOUSE VETERAN AFFAIRS COMMITTEE

SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATION

May 24, 1983

**International Radiation Research
and Training Institute (IRRTI)**

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PREFACE

This report is based on official documents of Operation Crossroads. Most of them are those of the late Colonel Stafford L. Warren who was the Chief of the Radiological Safety Section during Operation Crossroads. He had donated the declassified (formerly secret and top secret) papers to the library of the University of California, Los Angeles. Anthony and Mary Guarisco painstakingly went through them, sifted them and made copies available to us. Without their initiative, insight and work, this report would not have been possible. Walden Bello also provided some useful materials.

Dr. Karl Z. Morgan reviewed it and, as a scientist who was present at Operation Crossroads, provided many useful comments, insights and details. E. Cooper Brown, Glenn Alcalay and Kathleen Tucker also gave us useful comments and editorial help. Besides reviewing it, Bob Alvarez also arranged for us to work on this as a joint project. Lewis Wood and Diana Kohn typed it. We thank them all.

Chapter I

Summary and Conclusions

> "Col. Fields said that Gen. Groves [the director of the Manhattan Project which made the first atomic bombs] is very much afraid of claims being instituted by men who participated in the Bikini tests."
>
> Decontamination Report

The official documents of Operation Crossroads, which consisted of two atomic bomb tests, show that it was conducted in a manner which was grossly negligent regarding radiological safety for the 42,000 people who witnessed it. Conditions were particularly bad in regard to the second atomic test, named "Baker," on July 25, 1946.*

Test Baker was to be the first ever underwater explosion. Conditions were therefore particularly uncertain. The Radiological Safety Section had predicted that if the radioactive "column" from the explosion did not rise more than 10,000 feet -- as was in fact the case -- that radiological conditions would be "extremely serious." It was further predicted that the radioactive spray would utterly contaminate the target ships which "may remain dangerous for an indeterminable time thereafter."

The commanders responsible for the tests paid little heed. "Since the nature and extent of the contamination was completely unexpected," states the Decontamination Report written afterwards, "no plans had been prepared for organized demontamination measures." The documents confirm that a cavalier attitude toward safety prevailed among many of the officers who "insisted on the blind 'hairy-chested' approach to the matter [of radiological safety] with a disdain for the unseen hazard," according to Capt. Lyon of the Radiological Safety Section.

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*This report evaluates conditions on and after July 25, 1946, since the documents we have relate to that period. Most of them came from the papers of Col. Stafford L. Warren, a physician, who was the Chief of the Radiological Safety Section at Operation Crossroads.

Test Baker sent up a million-ton column of radioactive water, spray and steam about 6,000 feet high which came raining down on Bikini lagoon and the target ships, irrevocably contaminating almost all of them with the products of atomic fission and with plutonium, considered then as "the most poisonous chemical known."

On the very day of Test Baker, men were sent into the radioactive lagoon and the beaches to measure radioactivity and retrieve instruments. Within three days, they were also sent on highly radioactive ships to measure radiation and to retrieve equipment, instruments and experimental animals. All the non-target ships on which the men lived and worked were moved into the radioactive lagoon (some as early as the day of the test itself), and subsequently became contaminated. This action occurred in spite of Col. Warren's warning of "the possibility of an indirect hazard due to the concentration of radioactive products..."

Decontamination efforts were started on intensely radioactive ships even though "no one as yet know how to decontaminate" a ship. The Department of Defense exposed about two hundred ships to contamination at Bikini, thousands of miles away from substantial port facilities, without ever attempting to experimentally contaminate and then decontaminate a single ship! In spite of this admitted ignorance, men were exposed to the extreme dangers of attempting to decontaminate the target ships -- a futile effort which eventually had to be abandoned because of severe radiation hazards, and many of the ships were eventually sunk.

The operation subjected the personnel to large, and in some cases, increasing radiological dangers. Col. Warren noted that "contamination of personnel clothing, hands and even food can be demonstrated readily in every ship...in increasing amounts day by day." (Emphasis added)

There was a "widespread presence of an alpha emitter [plutonium] in the target area." Yet, "no alpha detectors for general field use were available." Little protection from inhalation or ingestion of this most deadly chemical was given to the men. Yet after shot Baker it was present on the ships' surfaces, in the evaporators, in the spray and mist which resulted from cleaning the target ships. Similar dangers existed with respect to the fission products.

Even in the case of gamma radiation (which is like X-rays), the radiation levels on the ships varied considerably and were intense in many places. Merely "lingering" in a place with high radiation for a few minutes could cause a dose ten times the daily "tolerance" limit.

As a result, it was common for men to be exposed over the daily "tolerance" limits. Men who slept aboard some target ships like the New York could have received 20 times the "tolerance" limit of 0.1 roentgen per day during a night. Lingering in a "hot-spot" whose locations were often unpredictable could cause the daily exposure limit to be reached in 45 seconds. Col. Warren found it "exceedingly common" that beta radiation doses to hands were above standard and "not infrequent" that they bordered on the erythema dose of 300 rads. We must note here that even the "tolerance" dose was very high by today's standards. According to Dr. Warren, the intermediate dose calculation on which it was based was "pure guess."

As a result, these limits for industry were repeatedly lowered so that they are today about one sixth of the value adopted then (on an annual basis). The "tolerance" limits at Bikini were more than 5,000 times the allowable limit of 5 millirems per year set by the Nuclear Regulatory Commission for nuclear power plant operators.

A great many men did not wear film badges — the minimal equipment required to measure gamma radiation. The instruments available to the radiation safety monitors were "experimental," many of which "all too often failed to work entirely," and when they did were often "erratic" and "misleading." "I am not an alarmist, Dr. Warren," wrote Dr. Myers, one of the safety monitors. "I do believe though that many of us probably received much more penetrating ionizing radiation than the instruments of very low beta-sensitivity were able to record."

The radiation dose standards set for the operation were those set by the Bureau of Standards for manufacturing plants. However, with atomic explosions, the conditions obtaining in industrial plants do not apply. The distribution of radiation was erratic and essentially unknowable. For hazards such as plutonium, no field instruments were available at all. Those available were erratic or failed to work entirely. Coupled with the "hairy-chested" "attitude of indifference" to radiation hazards on the part of many officers, it is no wonder that Col. Warren, the Chief of the Radiological Safety Section, exclaimed "I never want to go through the experience of the last three weeks of August [1946] again."

In terms of the hazards to an estimated 250,000 military personnel involved in atmospheric bomb testing, the Defense Nuclear Agency claims that overall "Exposures generally were well within established radiation exposure limits [and] there was no reason to expect any increased health risk."

The documents show that:

- Film badge records often exceeded daily "tolerance" limits.
- The "indifference" of officers to radiological safety led them to keep men for long periods in high radiation areas, often in violation of radiological safety rules and guidelines.
- Radiation instruments often did not work.
- The beta radiation danger was great both from external and internal sources -- it was "exceedingly common" to find dose limits being exceeded.
- Alpha contamination [plutonium] was "extensive and unpredictable" to the extent that "no one can say any place is safe for any length of time."

The Defense Nuclear Agency claims in particular that the "internal doses have proven to be essentially insignificant." Yet the observations above from the documents and Col. Warren's note that "any surface of any vessel may be in fact the residence of many lethal doses" shows that the Agency has not taken the facts into account while making this sweeping generalization. Indeed, it is more than likely that a great many of the men who were made to do work such as sweeping, scrubbing, hosing down decks, scraping and repainting the sides of some ships, inhaled and ingested very dangerous quantities of fission products and plutonium. Even changing clothes and eating was dangerous since fission products were found on clothing, food and hands "in every ship...in increasing amounts day by day."

The documents do not give us sufficient evidence to reconstruct doses. But they do definitely tell us that the Defense Nuclear Agency's claims of generally low doses and "insignificant" internal doses is without regard to essential facts and hence without scientific merit. This will continue as long as the Defense Nuclear Agency does not take the testimony of the atomic veterans regarding their activities as fundamental data needed for any and all dose reconstruction exercises.

Chapter II

Operation CROSSROADS: Introduction

> "...I never want to go through the experience of the last three weeks of August [1946] again. ..."[1]
>
> Col. Stafford L. Warren
> Chief, Radiological Safety Section

On July 1st and July 25, 1946, the U.S. Military conducted two atomic bomb tests off Bikini Atoll in the Marshall Islands. The first, Test Able, was exploded in the atmosphere above the lagoon. The second, Test Baker, was exploded underwater, in the lagoon.

Forty-two thousand people (mostly naval, but also Army and Air Force personnel, as well as civilians) witnessed these first atomic explosions after Hiroshima and Nagasaki.[2] Their purpose, according to the Joint Task Force One that was established to conduct them, was "primarily to determine the effects of atomic explosions against naval vessels" and "secondarily, to obtain as far as practicable the effects of atomic explosives against ground targets and airplanes and to acquire scientific data of general value."[3]

There were 84 "target ships" positioned around "ground zero" with instruments and animals and about 100 non-target ships. Test Baker was a shallow underwater detonation that sent a million-ton column of water spary and steam shooting six thousand feet up.* This very radioactive water came raining down on the lagoon, the beaches and the target ships and severely contaminated them. The blast precipitated immense waves which further contaminated all these places. Within a few days the non-target ships were moved back into the lagoon. These ships also became increasingly contaminated as radioactive materials were selectively deposited on and in them.

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*This evaluation of Operation Crossroads is about the period after this second test on July 25, 1946, because most of the documents on which it is based relate to that period.

The indications are that the overwhelming majority of people involved received considerable doses of radiation from a number of sources:

- Living and working aboard non-target ships;
- Retrieving experimental animals and equipment aboard the target ships and from the lagoon and beaches;
- Measuring the radioactivity in the area of the explosion and on the target ships;
- Attempting to decontaminate the target ships; and
- Preparing target ships for towing both within the lagoon and out of it.

Other people not present at the tests also no doubt received radiation doses as a result of subsequent experimental and decontamination work at Kwajalein Atoll, San Francisco and other ports. Almost all the target ships were so contaminated that they could not be salvaged and were sunk in deep water.

This evaluation of the radiological conditions at Bikini, their effect on the people present, and the adequacy or lack thereof of the radiation standards is based on the documents prepared by the participants in the test -- principally those of the personnel in charge of the Radiological Safety Section. The documents, which were obtained from the papers of the late Col. Stafford L. Warren, the Chief of that section, show that the manner in which the operations were conducted makes it impossible to precisely estimate how much radiation the various participants received. However, the evidence, both in regard to the radiation measurements and the conditions of life and work, also shows that it is likely that significant numbers of people probably received very high doses of radiation in tissue destructive ranges.

References to Chapter II

1. Col. Stafford L. Warren, letter to Dr. William G. Myers, December 31, 1946.
2. Joint Task Force One, Report on Atomic Bomb Tests ABLE and BAKER (Operation CROSSROADS), Navy Department, Washington, D.C., 15 November 1946.
3. Ibid., p. 1(A)(1)

Chapter III

Radioactive Contamination and Exposures

> "The initial contamination of surfaces was so great that reduction on the deck and other surfaces of 90% or more still leaves large and dangerous quantities of fission [products] and alpha emitters scattered about...
>
> "Contamination of personnel, clothing, hands, and even food can be demonstrated readily in every ship in the JTF-1 [Joint Task Force-One] in increasing amounts day by day."[1]
>
> Col. Stafford L. Warren
> Chief, Radiological Safety Section

The decision to conduct the atomic explosions Able and Baker was made only about six months prior to the first test on July 1, 1946. Within that time more than forty thousand men had to be assigned to and assembled at Bikini and other preparations, including those for radiological safety, had to be completed.

The conditions for radiological safety were not promising. An atomic explosion had never been set off underwater. In spite of this, the Navy did not attempt to experimentally contaminate and decontaminate a single ship before taking the fleet to Bikini, thousands of miles from any port with substantial relevant supporting facilities.

The radiological safety section had clearly warned of an "extremely serious" situation if the radioactive "column" from Test Baker did not rise more than 10,000 feet -- as in fact did happen. The prediction warned of "most significant contamination due to direct deposition of fission products...in the water of lagoon, on surface ships and in the fallout....On some target ships possibly within 1,000 yards of detonation, contamination make it essential that a detailed knowledge of each specific veteran's activities be used as basic data in estimating possible doses. Even so, the lack of adequate and systematic knowledge of the radiological conditions make it unlikely that any definitive statements can be made about specific persons who were present at Operation CROSSROADS for any length of time.

The "hairy-chested" "attitude of indifference" to radiological matters contributed largely to the dangers to which the personnel were subjected. Such attitudes contributed to extensive violations of radiological guidelines (not wearing protective clothing like gloves, for instance) -- in direct contrast to the assumptions of the Defense Nuclear Agency.

The information in the documents does not allow us to make even rough estimates of exposures. But it does allow us to dismiss as unwarranted any sweeping claims that the doses were "low" or "essentially insignificant" -- particularly as the Defense Nuclear Agency has made such claims without systematic reference to the veterans' detailed accounts of their own activities -- data we consider essential to any serious judgment on the matter.

References to Chapter V

1. U.S. Navy, "History of New York at Crossroads," undated.
2. Enclosure to letter by Capt. W.H. Loeffler, U.S. Navy to Veterans Administration, entitled: "History of USS Salt Lake City (CA-25) During Operation Crossroads (1946)," 17 August 1982.
3. Defense Nuclear Agency, "Fact Sheet, Subject: Nuclear Test Personnel Review (NTPR)," Washington, D.C., 1 March 1982.
4. Capt. W.H. Loeffler, U.S. Navy, Letter to National Veterans Law Center, 14 June 1982.
5. Preliminary Report of Nuclear Radiation Effects in Tests Able and Baker, from "013E" to "013," 25 September 1946; Appendix VII, para. E-7.

boarding inspection may be dangerous for weeks..."[2]

The warning of the possibility of serious contamination was ignored by those in charge of the operation, since no preparations for the possibility were made. The official Decontamination Report states:

> "Since the nature and extent of the decontamination was completely unexpected, no plans had been prepared for organized decontamination."[3]

This lack of planning meant that a great many officers were unprepared and did not take radiation safety seriously. They were given little training in such matters. The overwhelming majority of the rest of the 42,000 people received even less. Without a systematic program of radiological indoctrination for the personnel, a staff of less than 400 of the Radiological Safety Section was confronted with an almost impossible task.

Only a handful of these had any experience with radiological safety as it concerned atomic explosions. Many had no prior experience with radiological matters at all, civilian or military. Only thirty three "were given a fairly thorough two and a half month course."[4] The rest received some training aboard the USS Haven during the four weeks prior to the test.

A. The Contamination of the Ships

> "...no one yet knew how to decontaminate..."[5]
>
> Decontamination Report of
> Operation Crossroads

Immediately after Test Baker, it became apparent that almost all target ships not sunk by the explosions, as well as the waters of the lagoon and substantial portions of Bikini Island itself, had become severely contaminated. The result of the test corresponded to the most dangerous of the contingencies outlined in the prediction: "Extremely Serious."

In addition to contamination by the radioactive spray and rain, the explosion scoured up coral sand from the bottom of the lagoon which became radioactive and some of which was deposited on the target ships. A pile of sand on one target ship gave a reading of 200 roentgens per day -- two thousand times the "tolerance radiation limit per day set for personnel exposure -- twenty days after the test.[6] Some materials like wood decks and manila line selectively absorbed radioactive matter. In all these ways the ships became "dangerously hot,"[7] with the radioactivity spread out very unevenly and unpredictably.

On the very day of Test Baker, non-target boats and ships were sent into the lagoon. And only one day afterwards, the Commander of Joint Task Force One "authorized vessels at anchor in the lagoon to operate evaporators."[8] At that time, there was not only radiation from fission products and plutonium, but also very intense radiation from sodium-24 and other activation products.* This was again in contradiction to the warning in the safety prediction that:

> "there is the possibility of development of an indirect hazard due to concentrating radioactive products particularly in the form of salts in condensers, evaporators, and perhaps other places on ships entering the lagoon prior to the time that the contamination is greatly reduced. It is very difficult to evaluate the likelihood or the magnitude of this possibility -- but it must be anticipated."[9]

Apparently without checking the non-target vessels already sent into the lagoon for contamination by these means, the rest of the non-target ships were moved into Bikini lagoon to "regularly assigned berths" within six days of the test.[10] As a result, every non-target ship became contaminated in the manner predicted -- fission products and plutonium were selectively concentrated in salt water pipes, evaporators and condensers. In addition, coral, algae and other organic materials which selectively concentrated radioactive materials adhered to the body of the ship below the water-line, creating a decontamination problem of immense difficulty and danger. In fact, at the time "no satisfactory means of decontamination of underwater bodies and salt water systems in the Bikini area was apparent."[11]

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*Some of the neutrons produced by the fission of plutonium were absorbed by sodium rendering it radioactive, which was also true of some other elements in the seawater. These "activation products," particularly sodium-24, were a principal source of radioactivity in the lagoon and on the island for the first two days after Test Baker.

It was only after the radioactive ships reached San Francisco and other major ports, followed by extensive experimentation and work, that the levels of radioactivity were substantially reduced. In the meantime, the sailors received radiation doses as they lived and worked aboard. In fact, some radioactive ships were cleared for occupancy before decontamination because Operation CROSSROADS had contaminated so many ships that the Pacific Fleet was experiencing shortages. On September 9, 1946, the "Commander Western Sea Frontier" stated:

> "Districts have insufficient personnel to effect full clearance of vessels and, furthermore, no one yet knows how to decontaminate. Consequently, several APA's, Destroyer Division 72 and some auxiliaries have been cleared practically to meet operational requirements on the basis that they might as well continue to operate until methods of making them safe for overhaul are developed."[12]

In spite of the fact that no one knew for months after the tests how to decontaminate the partially contaminated non-target ships, attempts to decontaminate the much more severely and extensively contaminated target ships began only a few days after Test Baker.

B. The Irradiation of Personnel

> "Every contaminated place as evidenced by the gamma or beta radiation on any surface of any vessel may be in fact the residence of many lethal doses of this alpha emitter [plutonium]."[13]
>
> Col. S. L. Warren
> Chief, Radiological Safety Section

The lack of adequate preparation and training of the personnel and the insufficient number of radiological monitors began to be apparent within a few days. On non-target ships Dr. Karl Z. Morgan (Director of Health Physics at Oak Ridge National Laboratory) found that "radioactive salt water was being used to wash meat racks on the USS Saidor."[14] On the target ships, the radiation monitors noted the cavalier attitudes of many officers:

> "It appears that there is an attitude of indifference on the part of the ship's officers of the Prinz Eugen to the safety standard set by RadSafe. There is reason to believe that men are being kept aboard for longer periods than they should be and also that the standard of 0.1R has such a large safety factor that it can be ignored. Some of the men who were observed to be aboard the ship when we came aboard at 0800, ...were probably on the ship all that night and...until 1200 of the same day."[15]

Since some of the radiation levels measured were as high as 5 roentgens per day, which would have given the "tolerance" dose of 0.1 roentgen in about half an hour, some men aboard could have received 2 roentgens or more of gamma radiation during the night. In addition, a handwritten note on the memo says that there was "evidence of dry sweeping and sleeping aboard" the target ships. Sweeping was a hazardous practice because of the heightened danger of inhaling resuspended fission products and plutonium.

Almost a year later, Captain Lyon, evaluating radiological safety in response to a written complaint from Ensign Coffin, noted that there were officers "like Captain Maxwell who insists on a 'hairy-chested' approach to the matter with a disdain for the unseen hazard, an attitude which is contagious to the younger officers and detrimental to the radiological safety program."[16]

With this "hairy-chested" approach on the part of many officers, it is not surprising that enlisted men were violating basic radiological safety rules, such as sleeping on board target ships.

All the personnel at Operation CROSSROADS were constantly exposed to alpha, beta, and gamma radiation from plutonium and the other radioactive elements which were the result of the explosion. Alpha radiation consists of two protons and two neutrons tightly bound together (identical to the nucleus of a helium atom) which only penetrate the outer layers of skin. However, alpha emitters like plutonium are extremely damaging, even in microscopic amounts, when they are inhaled or ingested and become part of the body. They can then severely damage the cells around the spot where they become incorporated. Beta radiation consists of electrons, several thousand times [illegible] than alpha particles, and more penetrating. External beta radiatio[illegible] damages cells on or near the surface of the skin. However, be[illegible] radi[illegible] some fission and activation products have a range up to one [illegible].4 inch) in soft tissue. There is thus the risk of damage [illegible]nses of the eyes, male gonads, thyroid and some lymph n[illegible]. Beta emitters can be incorporated into parts of the body where they irradiate internally with the possibility of severe damage (e.g., strontium-90 to the bone). External whole body radiation comes primarily from gamma rays, which are high energy rays like X-rays, and which can penetrate through to various parts of the body. These rays can pass through the body without harming any cells, or kill cells, or damage cells.

C. Gamma Radiation

> "It is most likely that a number of persons not carrying film badges were likewise over-exposed."[17]
>
> Medico-Legal Board

On the first days after Test Baker, some of the target ships were so radioactive that the "tolerance" dose of 0.1 roentgen per day* would be exceeded in less than one minute. In spite of this, men were sent aboard ships in the first few days after Test Baker. Every one of several hundred test animals had been retrieved by these men within the first five days.[18] Similarly men and boats were sent into the lagoon and onto the beaches to measure radioactivity and retrieve equipment on the very day of the test. The lagoon and the beaches were extremely radioactive not only from fission products and plutonium but also because of the neutron-induced radioactivity in sodium. The gamma and beta radiations from sodium-24 are of very high energies and can cause (correspondingly) greater damage. Organic matter such as ropes and canvas had extremely high concentrations of radioactivity, in many cases "greater than 200 roentgen per 24 hours (the maximum which could be read with the instruments available."[19] It is most likely that many people received extremely high doses to all or part of their bodies near such things.

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*A roentgen is a unit which measures ionizing radiation by the amount of air it ionizes. It is no longer in common use, but is approximately equivalent to one rad which is a measure of the amount of radiation absorbed per gram of matter (1 rad = 100 ergs per gram; 1 roentgen approximately equals 93 ergs per gram of soft tissue). The "tolerance" dose on an annual basis was 30 roentgen.

Similar dangers persisted after the first few days when the average level of gamma radiation had subsided considerably. The deposition of radioactive materials was extremely uneven so that a person lingering in such a "hot spot" with a gamma reading of 200 roentgen would receive a dose in excess of the daily "tolerance" limit in about 45 seconds.

It is, however, impossible to estimate the full extent of overexposure for individuals from the documents that we have. The "attitude of indifference" of many officers to safety meant that it was common to find men aboard a "ship in large quantities without film badges or monitors. These men were in superstructures where readings of five roentgen [per day], were common." Such readings meant that a week of four-hour shifts might produce a whole body gamma dose in excess of .5 roentgens. Where film badges were worn, many cases of overexposure were recorded on specific days, even with respect to experienced radiation monitors.[20]

D. Beta Radiation

> "Contamination of hands and faces with beta emitters of intensities greater than tolerance (0.8R/day) is exceedingly common. It is not infrequent to find personnel with bare hands bordering on erythema dose levels if not removed within 24 hours..."[21]
>
> Col. S. L. Warren
> Chief, Radiological Safety Section

The average value of beta radiation found was ten times greater than gamma, though in setting the standards, the Medico-Legal Board had assumed this ratio would be only five-to-one. Consequently personnel receiving "tolerance" doses of gamma radiation were receiving, on the average, twice the "tolerance" dose of beta radiation. Moreover, much higher ratios of beta to gamma radiation were also common. It is probably for this reason that Col. Warren found overexposure to beta radiation "exceedingly common." It is to be emphasized that doses "bordering on erythema"* are equivalent to 300 rads or more to the skin. Yet, the conditions were such that, according to Col. Warren, it was "almost impossible to enforce the wearing of gloves continuously on badly contaminated ships....Nor is it feasible to expect them to take care of their contaminated clothes."[23]

The inhalation hazard for fission products from "fine dry particles, spray and fine water droplets" was so serious and insidious that even ordinary masks did nothing but provide a "false sense of security."[24] Only a special U.S. Navy "Breathing Apparatus" would be effective and it appears that such was not in general use for several weeks after Test Baker, if ever. We were not able to determine from the documents whether or not such apparatus was available for the decontamination work and not used.

Even changing contaminated work clothes was a hazard since it loosened radioactive particles and created a greater inhalation danger -- and possibly substantial internal doses.

E. Alpha Radiation

> "Every contaminated place as evidenced by
> the gamma or beta radiation on any surface
> of any vessel may be in fact the residence
> of many lethal doses of this alpha emitter
> [plutonium]. This alpha emitter is the
> most poisonous chemical known. It can only

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*Erythema is inflammation or reddening of the skin.

> be measured with very precise equipment which is not available and cannot be made available."[25]

Col. S. L. Warren
Chief, Radiological Safety Section

Plutonium, an alpha emitter and the basic ingredient of the atom bombs exploded at Operation Crossroads, was mixed in with the fission products and distributed throughout the test site in the same way as the fission products. Col. Warren noted on August 7, 1946, that "some of the most important ships have many lethal doses deposited on them and retained in crevices and other places." A few days later he concluded that "no one can say any place is safe for any given length of time" because of the unpredictable presence of alpha emitters and a lack of protective and measuring equipment.*

Still for weeks after the test, men boarded the target ships, hosed, scrubbed, swept and scraped them and prepared the ships for towing. The men even slept aboard them. They were thus constantly exposed to the danger of inhaling fine spray or particles which contained plutonium and/or fission products and neutron induced radionuclides. It is of particular relevance to note that recent research has revealed that "plutonium is concentrated on the sea surface and in sea spray."[28] The men were thus subject to a greater hazard from plutonium inhalation than previously believed. Just by being there and breathing the spray from the waves it was possible to inhale dangerous quantities of plutonium -- to say nothing of the activities that further stirred it up and increased its presence in the air as the men worked. In was, indeed, as Col. Warren came to conclude a few months later, an "insidious hazard" that pervaded the entire area.[29]

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*Karl Morgan's report[27] shows no alpha emitters in the few air samples tested for them with filtration equipment. This equipment worked erratically under the conditions of high temperature and humidity at Bikini. So its use was strictly limited. Moreover, the measurements were only made on a few non-target ships (date of measurement is uncertain) and did not apply to the conditions of resuspension of alpha emitters lodged in rust, paint, wood, etc. as the men worked. Chemical analysis showed extensive plutonium contamination of the ships. In one case, this applied to a sample which had been declared free of alpha emitters by an on-the-spot check.

F. Some Legal Aspects

> "Col. Fields said that Gen. Groves [the director of the Manhattan Project which made the first atomic bombs] is very much afraid of claims being instituted by men who particpated in the Bikini tests."[30]
>
> Decontamination Report

There is some evidence that many of the assurances regarding safety were made with an eye to answering future claims of radiation injury. The Medico-Legal Board declared that its initial purpose was to "reassure Col. Warren that the safety measures adopted by RadSafe were such as to attract no justifiable criticism, and to give what assurance was possible that no successful suits could be brought on account of the radiological hazards of Operation Crossroads."[31]

Given the extensive contamination, the lack of training of the personnel, the ignorance about decontamination procedures, the lack of adequate instruments, etc., the Radiological Safety Section clearly worked under some apprehension and considerable strain. When their contracts were up in mid-August, "attempts to delay these men were met with unanimous refusal."[32] Col. Warren was clearly seriously concerned about the overexposures and the serious hazards in which the men were working.

> "The target vessels are in the main extensively contaminated with dangerous amounts of radioactivity. Quick decontamination without exposing personnel seriously to radiation is not possible under the present circumstances and with present knowledge."[33]

This and similar statements show a reluctance to acknowledge the extent of the damage that had already occurred. Col. Warren's own statements, discussed above, document that the men were overexposed routinely and that they worked on ships which were 90% decontaminted were still very dangerously radioactive. Certainly, the knowledge of the Safety Section itself was much poorer right after Test Baker on July 25, 1946, than it was on August 7, 1946, when Col. Warren acknowledged the presence of widespread alpha contamination which could not be dealt with at all under the circumstances. Col. Warren's concerns about safety are evidenced in the fact that he recommended that the decontamination operations be shut down in a week. But extensive damage had likely already been done to large numbers of men who had been exposed to high levels of radioactivity in the course of their life and work in the weeks after Test Baker.

G. Instruments

> "The test turned out to be literally a hundred times larger than the original conception....We had to make decisions on instruments...at a time when the manufacturing program was non-existent... and we had to make essentially what could be made."[34]
>
> Col. S. L. Warren
> Chief, Radiological Safety Section

> "The 'experimental nature' of the instruments might be criticized as implying 'not proven' or known and hence possibly unsafe."[35]
>
> Capt. George M. Lyon
> Safety Advisor, Radiological Safety Section

The radiological danger to the personnel because of the nature of the tests, the haste with which it was conducted, and "the attitude of indifference" on the part of many officers was compounded by unsatisfactory and untested instruments. For some crucial radioactivity measurements, instruments were not available at all.

The X-263 was, for instance, one of the basic instruments at the disposal of the monitors. Little more than a month prior to the first test, Donald Collins discovered that only 1% of the crucial counter tubes in the second shipment were acceptable, compared to 90% in the first.

The instrument had not been field tested and performed poorly. Dr. William Myers who had been an enthusiastic participant in Operation Crossroads noted that the X-263 "too often failed to function entirely." When working, it "became very erratic and was often misleading on the 20X scale when it was essential that it function well." Finally, it "did not measure high enough radiation intensities."[36] The documents repeatedly record questions regarding the reliability of this instrument to accurately locate contaminated areas.

Even when it did work, it could only measure gamma radiation reliably. It did not measure alpha radiation at all. Its measurements of beta radiation were often unreliable.

The instrument thus provided some sketchy data about gamma radiation and much less about beta radiation. There were no field instruments at all to measure alpha radiation from substances such as plutonium. Karl Morgan and his team from Oak Ridge measured some air samples with filtration equipment to check for alpha radiation. However, this equipment did not work properly under the high temperature and humidity conditions at Bikini. It was therefore not used as a field instrument.[37]

Finally, almost all radiation measurements in the field related to external doses. There was no systematic measurement at Bikini for internal doses which personnel might get and continue getting for the rest of their lives by the inhalation, ingestion or absorption of fission products or alpha emitters like plutonium at Operation Crossroads.

Thus, every aspect of Operation Crossroads, especially after July 25, 1946, was fraught with danger for the 42,000 people present. The documents show that because of the indifference to safety, the lack of caution in spite of grave ignorance, and other factors, it is probable that large numbers of personnel were exposed to very high levels of radiation, particularly internal doses from fission products and plutonium, which continue to irradiate long after the Operation was declared closed and the target ships sunk.

References to Chapter III

1. Stafford L. Warren, Memorandum to Commander Task Group 1.2, USS Haven, 13 August 1946.

2. R. J. Buettner, "Safety Prediction - Test Baker," undated.

3. Director of Ship Material. Radiological Decontamination of Target and Non-Target Vessels, 3 vols., U.S. Navy, undated; vol. 1, p. 4.

4. U.S. Navy, Report on Atomic Bomb Tests Able and Baker (Operation Crossroads). Washington, D.C., 15 November 1946; p. VII(C)(6).

5. cf. supra, #3; vol. 1, p. 25.

6. Preliminary Report of Nuclear Radiation Effects in Tests Able and Baker, From "013E" to "013," 25 September 1946; Appendix VII, Section E.

7. cf. supra, #4; p. VI(D)(41)

8. Ibid., p. VI(D)(21)

9. cf. supra, #2; p. 17.

10. cf. supra, #4; p. VI(D)(45)

11. cf. supra, #3; vol. 1, p. 18.

12. Ibid., vol. 1, p. 25.

13. cf. supra, #1.

14. Karl Z. Morgan, "Final Report on the Alpha, Beta, Gamma Survey Sec.," 6 August 1946.

15. Radiological Safety Monitors for Prinz Eugen, memorandum to Lt. Comdr. Wulfmann, "Subject: Radiological Conditions aboard the USS Prinz Eugen," USS Haven, 10 August 1946.

16. George M. Lyon, Memorandum to Admiral Parsons, Subject: "Ensign Coffin," 5 May 1947.

17. Medico-Legal Board, Minutes of 10 August 1946 meeting.

18. cf. supra, #4; p. VI(D)(44).

19. cf. supra, #6; Appendix VII, Section E.

20. cf. supra, #17.

21. Stafford L. Warren, Memorandum to the Commander Joint Task Force One, Subject: "Occupancy of Target Vessels as Influenced by Intensity of Radiation of Various Types on Target Vessels," 7 August 1946.

References to Chapter III - continued

22. cf. supra, #6; Appendix VII.

23. cf. supra, #7.

24. Ibid.

25. cf. supra, #1.

26. cf. supra, #21.

27. cf. supra, #14.

28. J.A. Garland and R.C. Chadwick, "Plutonium Suspension from Seawater," Health Physics, vol. 41, August, 1981, pp. 279-83.

29. Stafford L. Warren, Memorandum to Major Gen. L.R. Groves, Subject: "Clearance of 'Discussion on product contamination after underwater bomb detonation' during part of informal talks on safety at Bikini," 9 October 1946.

30. cf. supra, #3, vol. 3, p. 112.

31. Medico-Legal Board, "Appendix XX: Report of the Medico-Legal Board," 15 August 1946.

32. cf. supra, #21.

33. Ibid.

34. Stafford L. Warren, Letter to William G. Myers, 31 December 1946.

35. cf. supra, #16.

36. William G. Myers, Letter to Stafford L. Warren, 28 August 1946.

37. Karl Z. Morgan, personal communication, May 21, 1983.

Chapter IV

Radiation Standards

> In view of the experience with this whole subject [of radiation standards] in the past, it is my recommendation that no attempt be made to fix a range of tolerances for military operation....They would hardly be worth the paper they are printed on..."[1]
>
> Col. S. L. Warren
> Chief, Radiological Safety Section
> in January, 1947

An irradiation of the whole body at a rate of one-tenth of a roentgen per day (0.1R) was set as the "tolerance" dose above which a person would be considered "over-exposed for that day."* This limit was set in 1934[2] and was "the tolerance limit set up by the United States Bureau of Standards ...for manufacturing plants in the U.S."[3] It was based on a study of three technicians who were exposed to gamma radiation from radium at levels of exposure that did not produce immediately observable damage, mainly reddening of the skin. This "threshold" concept was similarly defined as the dose of radiation measured by the length of time it took for a given radiation flux to produce reddening of the skin.

Later the first dose limit for internal exposures was set in 1941 at 0.1 microcurie "Maximum Body Burden" of radium-226.[4] After the agonizing deaths of several radium dial painters in the United States, it was assumed that one ten-millionth of a curie of this internal alpha emitter was extremely dangerous. In other words, by 1946 and until 1949, the internal and external dose limits were mainly designed to protect people from tissue damage like erythema, anemia and acute forms of radiation damage and did not protect against chronic forms of damage such as carcinogenesis.

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*The annual limit was 30 roentgen.

At the outset, it might have seemed eminently reasonable to apply the "tolerance" limit for industries to atomic explosions. But as the days wore on, after the disastrous contamination which resulted from Test Baker, it became more and more clear that a gross mistake had been made, even if one granted the unwarranted presumption of adequacy to the industrial "tolerance" limits which were subsequently considerably reduced by the National Commission on Radiation Protection to 0.3 rem per week in 1949 and to 5 rem per year in 1957.

In industries, the locations and intensities of the primary sources of radiation are better known and fixed. Well-calibrated instruments can be used to better chart the radioactivity at various locations. Laboratories are available for analysis on site. Thus the wearing of film badges by personnel can be expected to give a fair indication of external whole body radiation once the film badges are developed and read. Even this is no assurance of adequate safety. For instance, the problem of internal intake of radioactive materials must still be addressed.

Conditions after an atomic explosion, particularly one such as Test Baker which contaminated and set in motion a vast quantity of radioactive water and spray, are entirely different. The location of the radioactive materials is unknown. There were no remote measuring instruments, so that monitors had to go into highly radioactive areas in order to get an indication of how radioactive the general area was.

Even once an area had been declared approachable for a certain time interval, using measurements from experimental and often faulty instruments, there was an immense and unpredictable variability in the radiation. The maximum radiation was, on some target ships such as Salt Lake City, fifty times the average and radiation levels could vary by a factor of one hundred within a short distance.[5]

Besides these differences in conditions, there was the widespread presence of beta and alpha radiation on the ships.

The Medico-Legal committee, recognizing this and the fact that beta radiation levels were often several times the gamma, adopted the following exposure standard one week after Test Baker:

> "The permissible dose of irradiation to the entire body will not be exceeded if the gamma irradiation is held below 0.1R per 24 hours. (This is on the basis of limit of 0.5R of beta per 24 hours)."[6]

Thus the permissible dose for external beta irradiation, which can seriously affect the skin, hands and all exposed parts of the body as well as certain soft tissues near the surface like lenses of the eyes, was set at five times the gamma level. Even this was on the presumption that beta radiation on the average was only five times the gamma. (The routine film badges which were issued to personnel measured only gamma radiation.) In practice the ratio of beta to gamma radiation was extremely variable and could reach one hundred or more. Karl Morgan measured one beta radiation level six hundred times the gamma.[7] Thus a standard for beta radiation based on gamma readiation measurements was inherently defective. It was in this regard that Col. Warren noted:

> "Practices which can be applied with safety in industrial plants through long time supervised training and guidance cannot be employed with safety in the attack on the present problem...."[8]

The problem of measuring the extent of a ship's alpha contamination turned out to be insurmountable even after samples of materials from contaminated ships were sent to laboratories. Dr. Herbert Scoville commented on the measurements obtained from samples from a non-target ship:

> "The total [alpha] contamination on the ship is estimated to be about 2000 micrograms, but this value may be in considerable error due to different degrees of contamination in various locations and the difficulty of averaging the various readings in order to obtain the total contamination on the ship...."[12]

Since there was no satisfactory way to address the problem of alpha measurements and standards directly for unpredictably contaminated ships, the problem of standards for exposure became a much more difficult one. According to the Decontamination Report:

> "....The revelation of the presence of alpha emitters with the fission products, the lack of instruments for detecting alpha emitters and the absence of standards for safe exposure to them, had introduced an indeterminate factor in all deliberations as to radiological safety. Consequently.... 0.01R/day... was selected as the arbitrary external radiation intensity below which all salt water systems should be reduced for clearance of active ships."[8]

Thus, the military decided on an "arbitrary external radiation intensity" ten times lower than the previous standard of 0.1R/day in part to compensate for an inherently unpredictable distribution of plutonium and in part to account for the much more rapid decay of gamma radiation sources compared to alpha emitters.

Precisely because it was an arbitrary standard, the military found that "no radiologists of recognized authority were ready to declare the figure safe until a study had been made of all the factors involved."[13]

If the situation regarding external radiation standards was highly unsatisfactory, internal irradiation, including alpha emitters, was much worse. In fact, the documents we have examined indicate there were no formal standards for alpha emitters at all, and no operable field instruments to measure alpha radiation. Tolerances, based on the Manhattan Project, were discussed, and the doses implicit in these were very high indeed.

In a memo to Col. Warren, R. R. Coveyou (one of seven surveyors brought in by Karl Morgan from Oak Ridge National Lab), presented sample calculations showing how much plutonium sailors would inhale if the surfaces being worked on were contaminated up to a suggested tolerance level.[9] Using current methods of calculation, we estimate that one of the highest cases cited would amount to a one to nine rem to the bone surface per four hours working shift.*[10] Thus for a twenty-day working month, the dose would be enormous: 20 to 180 rem. A few days prior to Test Baker, the Medico-Legal Board had raised the "question as to the actual danger to CROSSROADS personnel from plutonium dispersed by the Baker nuclear explosion...."[11] but thought the problem manageable and the plan of the Radiological Safety Section to be "adequate" even in the worst situation.

In actual practice, the Radiological Safety Section had no plan to deal with plutonium or other alpha emitters as such. It had presumed that gamma radiation measurements would be adequate to the job and paid no specific attention, as far as can be discerned from the documents, to "the most poisonous chemical known."

Two weeks after Test Baker, it had become evident that alpha radiation was a serious hazard which was "extensive and unpredictable," the more so as no field instruments were available to measure it.

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*This would be the total internal dose to the bone surface, over a lifetime, resulting from a four-hour shift.

The situation proved so intractable and dangerous that the standard was once again lowered tenfold:

> "...it was ruled that final clearance maximum allowable readings for all ships would be .001R/day gamma for shielded readings and .005R/day combined gamma and beta for exposed surfaces pending further developments."[14]

Even so, there was no assurance that someone would not ingest a deadly amount of plutonium.

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1. Stafford L. Warren, Memorandum to Admiral W.S. Parsons, Subject: "Wartime Radiation Tolerances," 18 January 1947.

2. Radium Protection for Amounts up to 300 Milligrams, U.S. Bureau of Standards Handbook #18, 17 March 1934.

3. Stafford L. Warren, Summary of Lecture on Safety to Monitors, 31 May 1946.

4. Safe Handling of Radioactive Luminous Compounds, Handbook of the National Bureau of Standards H-27, May 2, 1941.

5. Preliminary Report of Nuclear Radiation Effects in Tests Able and Baker, from "013E" to "013," 25 September 1946; Appendix VII.

6. Medico-Legal Board, Minutes of meetings on 2-3 August; 3 August 1946.

7. Karl Z. Morgan, personal communication, May 21, 1983.

8. Stafford L. Warren, Memorandum to Commander Joint Task Force One, Subject: "Occupancy of Target Vessels as Influenced by the Intensity of Radiation of Various Types of Target Vessels," 7 August 1946.

9. R.R. Coveyou, Memorandum to S.L. Warren, Subject: "Gamma-Alpha Equivalence for Flat Surfaces," 26 August 1946.

10. K.F. Eckerman, et al., "Internal Dosimetry Data and Methods -- Part 2, vol. 1: Committed Dose Equivalent and Secondary Limits," NUREG/CR-1962, vol. 1, February 1981.

11. Medico-Legal Board, "Report of the Medico-Legal Board on Plutonium Hazard Associated with Test Baker," 22 July 1946.

12. Herbert Scoville, Letter to Captain G.M. Lyon, Subject: "Comments on Results of the Investigations on the USS ROCKBRIDGE," 21 November 1946.

13. Director of Ship Material. Radiological Decontamination of Target and Non-Target Vessels, 3 vols., U.S. Navy, undated; vol. 1, p. 41.

14. Ibid.

Chapter V

Operation CROSSROADS and the Defense Nuclear Agency

> "The potential for such [alpha] exposure at CROSSROADS was very low."[1]
>
> Defense Nuclear Agency

> "Compared to other tests, exposures for CROSSROADS are relatively low."[2]
>
> U.S. Navy

In numerous Veterans Administration cases brought by CROSSROADS veterans, the Defense Nuclear Agency has maintained that radiation doses, both internal and external, were low. In its dose assessments, the Agency assumes that the radiological guidelines were obeyed, that the standards were adequate, and that the radiation monitoring equipment worked well. Using these assumptions, the Defense Nuclear Agency arrives at its conclusion that the doses were low for specific veterans, without systematically taking into account what that particular veteran did during and after the test.

The official records of Operation CROSSROADS show that the Defense Nuclear Agency's assumptions are without foundation in fact -- which renders its conclusions about doses unscientific. The Joint Task Force had not made any plans for decontamination. Nor did anyone know how to decontaminate a ship. The radiation standards were several times today's levels for external gamma and beta radiation. There were no official standards for alpha radiation or internal doses, so far as can be determined. Many of the instruments did not work well -- and most of them were experimental ones made in great haste. There were no field instruments at all for alpha radiation -- and eventually it turned out to be impossible to estimate the actual extent of the alpha contamination of the ships. All that could be determined was that it was "extensive and unpredictable."

The Defense Nuclear Agency has dismissed the internal dose as "essentially insignificant."[3] Yet Col. Warren, as noted above, the Chief of the Radiological Safety Section of Operation CROSSROADS, stated that "no one can say any place is safe for any length of time" because "any surface of any vessel may be in fact the residence of many lethal doses of this alpha emitter." Since the men were sweeping, scrubbing, hosing down and even sleeping on heavily contaminated ships, the Defense Nuclear Agency's outright claim must be dismissed as baseless. Indeed, the circumstances make it likely that a great many men absorbed significant amounts of alpha emitters which continue to irradiate the portions of their bodies where they are incorporated.

These comments about alpha emitters also apply to internal doses from fission products. In addition, the Radiological Safety Section found that external overexposures to hands were "exceedingly common" and that very high doses bordering on erythema were "not infrequent."

In its calculations of beta radiation dose, the Defense Nuclear Agency has further claimed that the beta and gamma radiation levels were approximately equal.[4] In contrast, the documents show that beta radiation levels averaged ten times the gamma levels and reached up to one hundred times in certain areas.[5]

The presence of radiological "hot spots," many of which were unknown, make it likely that many men received high doses merely by lingering in such areas. In general, the unpredictable and ill-defined nature of the contamination make it essential that a detailed knowledge of each specific veteran's activities be used as basic data in estimating possible doses. Even so, the lack of adequate and systematic knowledge of the radiological conditions make it unlikely that any definitive statements can be made about specific persons who were present at Operation CROSSROADS for any length of time.

The "hairy-chested" "attitude of indifference" to radiological matters contributed largely to the dangers to which the personnel were subjected. Such attitudes contributed to extensive violations of radiological guidelines (not wearing protective clothing like gloves, for instance) -- in direct contrast to the assumptions of the Defense Nuclear Agency.

The information in the documents does not allow us to make even rough estimates of exposures. But it does allow us to dismiss as unwarranted any sweeping claims that the doses were "low" or "essentially insignificant" -- particularly as the Defense Nuclear Agency has made such claims without systematic reference to the veterans' detailed accounts of their own activities -- data we consider essential to any serious judgment on the matter.

NAAV
NATIONAL ASSOCIATION
OF ATOMIC VETERANS
WASHINGTON OFFICE • SUITE 605, 236 MASSACHUSETTS AVENUE, N.E., WASHINGTON, D.C. 20002 • (202) 543-7711

PREPARED STATEMENT OF
VICTOR P. TOLLEY
NAAV NATIONAL COORDINATOR
TO THE
HOUSE COMMITTEE ON VETERANS' AFFAIRS
MAY 24, 1983

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

I have been very active with the Hiroshima and Nagasaki Veterans as of November 1979. I have served on the policy board of that organization and when they merged with NAAV in 1981 I became the National Coordinator for them.

During that time I have received over 500 letters from the veterans or their families telling me of their health problems. These health problems are staggering.

The most serious is that of muliple myeloma. As of this date I have recorded 21 cases of this dreaded disease. Medical Science tells us that the norm for multiple myeloma would be 5 or less out of a population of 10,000. We have discovered 21 out of 500 veterans we have been able to locate. My Doctor recently told me if he diagnosed just one case out of 400 patients he would be concerned.

Of course there are other blood disorders and bone and muscle problems affecting these veterans. Late emerging cancers such as leukemia and malignant lymphona appear. There is a great deal of skin cancer among these veterans.

I believe these illnesses affecting the veterans that served in Hiroshima and Nagasaki are very serious and a complete health study should be made at once. Time is running out for all of us.

The following supplemental materials are provided to the Committee in support of NAAV's testimony concerning radiation effects. Thank you.

HIROSHIMA/NAGASAKI VETERANS
MULTIPLE MYELOMA VICTIMS

Anderson, Thomas I (branch of service unknown)	DECEASED
Bartha, James G. U.S. Army Hiroshima/Nagasaki	DECEASED
Bender, Howard F. U.S. Army Hirsoshima	DECEASED
Copolla, Harry Marines Nagasaki	DECEASED
Lasky, Alvin Marines Nagasaki	DECEASED
O'Donnell, John Seabees Nagasaki	DECEASED
Peterson, Robert L U.S. Army Nagasaki	DECEASED
Proctor, George Marines Nagasaki	DECEASED
Ralph, Harold J. Marines Nagasaki	DECEASED
Ruhl, Carl U.S. Navy Nagasaki	DECEASED
Savage, Philip U.S. Navy Hiroshima/Nagasaki	DECEASED
Sirani, Anthony U.S. Army Hiroshima	DECEASED
Trent, Donald F. U.S. Air Force both cities	DECEASED

Benson, Willard E. 1st Marine Air Wing both cities

Bonebrake, Richard Marines Nagasaki

Gellinas, Robert Marines Nagasaki

Haworth, Floyd Marines Nagasaki

Hilburn, John U.S. Army Hiroshima

Micheau, Napolean U.S. Army Hiroshima

Maxwell, A. R. Prisoner of War Nagasaki

Morris, William U.S. Navy Nagasaki

This list was compiled from some 500 responses received from Hiroshima/Nagasaki Veterans or families......

Victor F. Tolley
4160-85 Jade Street
Capitola, Ca. 95010
(408) 462 1793

NEWS ITEMS ON SCIENTIFIC STUDIES OF ATOMIC RADIATION

Compiled by

Victor F. Tolley - Hiroshima Nagasaki Veterans

WASHINGTON POST April 13, 1980: Two months after the atomic bomb was exploded over Nagasaki in 1945, two U.S. government research teams found low-level radiation in the Japanese city's outskirts that was about twice the level now considered safe for nuclear workers and over ten times the radiation safety standard for the general public.

BOSTON UPI January 22, 1981: People exposed to radiation are significantly more likely to develop bone marrow cancer than those who have had no such exposure, a study published today concluded. The report in the New England Journal of Medicine compiled information available from TWO DECADES of research on the link between radiation and cancer in atomic bomb survivors, nuclear workers, uranium miners and millers, radioligists and patients given therapuetic X-rays.

SAN FRANCISCO CHRONICLE Sat. May 9, 1981: JAPAN A-BOMBS STILL PLAGUE S.F. SURVIVORS. Late emerging cancers in the survivors continue to be discovered, according to Dr. Michio Yamakido of the Hiroshima medical school. Although leukemia cases have declined since their peak in the 1950s, tumors of the lung, the breast, the stomache and multiple meloma - a maligant growth of specialized bone marror cells - show up at a rate three to four times the incidence in unexposed Japanese populations, he said. And they are worried the late affects of radiation so long ago will finally cause them disease. That worry is not unrealistic as we just don't know how long the hidden affects of radiation take to show themselves.

GUAM "SUNDAY NEWS" - May 17, 1981: Arthur Upton, former director of the National Cancer Institute, told Science Magazine the new data bolsters the argument that there is no safe level of radiation exposure.

SCIENCE, VOL 212 22 May 1981 page 900: Some of the most important data on the affects of nuclear radiation on humans may be wrong, according to new research being done at the Lawrence Livermore Laboratory in California and the Oak Ridge National Laboratory in Tennessee. The new findings are far from welcome, as one consultant in this work says, for all the revisions are mobing in the wrong direction - a direction that will worry the advocates of nuclear power. Government physicists have recalculated the data on the radiation fields at Hiroshima and Nagasaki and produced some unexpected results. Their statistics show that most of the cancer caused by those bombs came from low LET gamma rays,* suggesting that this common type of radiation is more hazardous than had been assumed before.

*The terms "low LET and high LET" (for linear energy transfer) refer to the physical quality of the ray. Low LET radiation loses relatively little energy as it travels along its course, and includes electrons, gamma rays and X-rays. High LET radiation loses energy more rapidly as it travels, and includes beams of neutrons and protons.

GUAM - PACIFIC DAILY NEWS - May 30, 1981: A new study by the Lawrence Livermore Weapons Laboratory im California concludes that the Japanese survivors actually experienced much less exposure to neutrons and much more exposure to gamma rays, than was previously thought. Thus gamma rays, which are far more common, seem to have caused most of their cancers.

SUNDAY OREGONIAN, June 14, 1981: New evidence about the kind and amount of radiation that was given off by the atomic bomb at Hiroshima suggests that much of what is known about the affects of radiation on human beings is wrong. In the last few months, physicists at Lawrence Livermore Laboratory near San Francisco have published findings that show the accepted estimates of the radiation bomb are seriously in error. The new scientific evidence shows that a lot of influences that were drawn from the Japanese data are just wrong. That statement made by Edward P. Radford, director of the Center for Enviornmental Epidemiology at the University of Pittsburg and chairman of the National Academy of Science's committee for the biological affects of ironizing radiation.

SCIENCE MAGAZINE August 28, 1981: WINDSCALE ACCIDENT 24 YEAR PERSPECTIVE: On October 10, 1957, during a routine operation - the air-cooled, plutonium producing Windscale nuclear reactor on the west coast of England caught fire. The next day, the reactors incandescent interior was cooled with water, sending aloft a large plume of vapor contaminated with radioactive iodine, strontium, cesium and ruthenium; carried along by the wind, it passed over millions of people in England Belgium and other European countries along its passage northeastward.

That was more than 20 years ago, but only now have the affects on people's health have formally been estimated. A study by Peter J Taylor of Oxford based Political Ecology Research Group (perg) predicts that 10 to 20 persons will die of thyroid cancer in the next few decades as a consequence of their exposure in 1957 principally to radioactive iodine. (Radiation often takes decades to work its lethal mischief on people).

Gordon R. Thompson of the Union of Concerned Scientists says a major nuclear reactor accident could involve one-thousand times more the radiation release of a Windscale-type accident, in which case the public health affects might be considerable. We still don't know for sure

JOURNAL - Stevens Point Wisconsin - August 7, 1981: On the 36th anniversa of the dropping of the atom bomb on Hiroshima Thursday, a "White Paper" prepared two years ago by Japanese Scientists and social workers, with several sections brought up to date to this February, has been published in English in New York, London and Tokyo. Though the evidence is presented factually, the findings are potent emotionally.

Periodic checkups that are still being done on those exposed to atomic bomb radiation show that an "irreversible injury" remains in the cells tissues and organs, leading to such blood disorders as leukemia, multiple myeloma, malignant lymphoma and others related to exposure to the atomic bomb.

The incident and degree of severity of eye damage, called "atomic bomb cataracts", run parallel to the radiation doses. The longer the exposure and the closer the victim was to the point of detonation the greater the developments of cataracts years after the bombing. Deaths from Leukemia among exposed survivors has been increasing.

Those exposed to nuclear radiation live with the threat to their health from "delayed radiation affects." They fear that their children will be unhealthy or deformed. They live with worries of medical expenses, decline of ability to work, economic instability and discrimination against them by non-victims.

From the "Careless Atom" by Sheldon Novick

Statement of Clemente Attlee, British Prime Minister at the time the first Atom Bomb was dropped. "Of course, at the time we knew nothing, I certainly knew nothing about the consequences of dropping the bomb except that it was larger than an ordinary bomb. We knew nothing whatever at that time about the genetic affects of an atom explosion. I knew nothing about fallout and all the rest of what emerged after Hiroshima. As far as I know, President Truman and Winston Churchill knew nothing of these things either, nor did Sir John Anderson who coordinated research for our side. Whether the Scientists directly concerned knew or guessed, I do not know. But if they did, then as far as I am concerned they said nothing of it to those who had to make the decision"

(BRACK)

NATIONAL ASSOCIATION
OF ATOMIC VETERANS
P. O. Box 755, Bernardsville, N.J. 07924 Tel. 201-221-1874

May 3, 1983

G. V. Montgomery, Chairman
United States House of Representatives
Committee on Veterans Affairs
335 Cannon House Office Building
Washington, D.C. 20515

Dear Mr. Montgomery:

I am writing to you as a veteran of an atomic test. While in the Marine Corps I witnessed Shot "Dog" of the Tumbler Snapper Series on May 1, 1952. The test occurred at Yucca Flats in the Nevada Test Site (NTS).

In 1982 the Defense Nuclear Agency, as Executive Agency for the Department of Defense, released for public information DNA 6019F, DNA 6020F and DNA 6021F. These three volumes reportedly portray what happened at these tests. As an eye witness to Shot "Dog" I have to disagree with what is stated in these books. I refer to the following statements:

> DNA 6019F - Chapter 5 - Page 127
>
> "Radiation Protection at Operation Tumbler Snapper Personnel Dosimetry" - "Issuing and processing film badges and evaluating the gamma radiation exposures measured by these devices."
>
> I, myself, was not issued a film badge. As National Coordinator for the National Association of Atomic Veterans (NAAV) for the Tumbler Snapper Series, I correspond with almost 200 atomic veterans. Less than 10 have reported wearing film badges.
>
> DNA 6019F - Chapter 5 - Page 127
>
> Briefing - "informing observers and project personnel of radiological exposure potentials and the current radiological conditions in the test area."
>
> I, nor any other atomic veteran I know were told of radiological exposure potential or the current conditions of the test area. Three nuclear devices were detonated between 4/1/52 and our test date 5/1/52, one of which was a 31KT device. We lived, ate, and slept in this area without any knowledge of what Beta and Gamma rays we ingested. Nor were we told of that possible danger.

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DNA 6019F - Chapter 5.1.3

Protective Equipment - The paragraph states that no protective clothing was worn. This is true. Fatigues tucked into boot tops and sleeves and collars buttoned were not enough protection to minimize contamination to underclothing and skin. The fact that I and many other atomic veterans have had skin problems for 10, 20 or 30 years shows that we were not adequately protected.

DNA 6019F - Chapter 5.1.5

Decontamination - "For all shots the limit of personnel and vehicle contamination was 0.01 R/H."

This statement has to be false. In DNA 6020F, page 195, a map (Figure 5-8) shows the radiation intensity for Shot "Dog" on 5/1/52 to be 300 R/H at Ground Zero. The Marines at this test inspected Area T approximately 1/4 mile away from Ground Zero. The reading could not vary 300 R/H in 1/4 mile. We were all exposed to a higher reading than that stated of 0.01 R/H. The Test Commander did not allow the troops to go to Ground Zero on that day because of the 300 R/H reading. Because of the radiation levels, much of the recovery work at Ground Zero was delayed until after May 2. The Ground Zero area was not declared open until 10 days after the shot.

DNA 6019F - Page 13 - Paragraph 2

"Moreover these documents sometimes have inconsistencies in Vital Facts."

This is the truest statement in this 3 volume set. What I have mentioned here are only some of the inaccuracies. There are many others.

I bring these facts to your attention because of your position as Chairman of the Veterans Affairs Committee.

I hope that you will find time to verify my statements and with that knowledge look more favorably on Atomic Veterans petitioning the Government for disability compensation.

NAAV

NATIONAL ASSOCIATION
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P. O. Box 755, Bernardsville, N.J. 07924 Tel. 201-221-1874

The Atomic Veterans are not looking for a handout, simply justice as veterans who served their country honorably in a time in history when a threat of nuclear war with Russia was thought imminent and our Government needed knowledge as to what the effects of a nuclear detonation would have on man. We feel we were the guinea pigs.

Thank you for any assistance you can give the Atomic Veterans of America.

Sincerely,

Robert J. Brack

Robert J. Brack

(RALPH)

May 8, 1983

Honorable G. V. Montgomery
Member of Congress
House Veterans Affairs Committee
Washington, D.C.

Reference: VALIDITY OF PRESENT DNA INFORMATION - LEVELS OF RADIATION EXPOSURE FOR HIROSHIMA/NAGASAKI, JAPAN OCCUPATION FORCES

SPECIFIC REFERENCE - CASE OF HAROLD J. RALPH - XC 12 754 359
Multiply Myeloma Victim

The Veterans Administration has established a pattern of denying all Hiroshima and Nagasaki veterans' claims, including the claim of Harold J. Ralph, Second Marine Division, Co. B, 1st. Bn., 6th. Regiment, Nagasaki veteran. Denials are based on assumed, estimated and incredible figures of the so-called FACT SHEET released by the DNA on Aug. 6, 1980. Why did the DNA publish such a report? It was an all out effort by the DNA to discourage the occupation atomic veterans and their next-of-kin from filing claims for service-connected disability and service-connected death benefits. "Discouragement was the name of the game." The DNA fairy tale conclusion of that FACT SHEET discloses that no G.I. serving with the occupation forces received more than one rem of radiation.

To assume that six weeks following the atomic blast the city of Nagasaki posed no health threat to residents or occupying forces indicates an unhealthy credulity on the part of the DNA. No consideration was given to the fact that these forces were not robust, healthy Marines fresh off the Camp Pendleton Parade Grounds. These were war-torn, fatigued marines, who had battled in the Solomon Islands, the Gilbert Islands, at Saipan, Tinian and Okinawa - to name a few. They were suffering from the mental pressures of war and the physical effects of Malaria and other Pacific Jungle Island diseases. Exposing them to radiation without adequate precautions about contaminated food and water, no dosimetry badges and no protective clothing was an irresponsible and unconscionable government move. Permitting them to be discharged without medical follow-up shows gross negligence by our government.

The Nov. 26, 1979 NEWSWEEK article entitled "A-BOMB VETERANS: A PLEA FOR HELP" by Eileen Keerdoja, carries a ridiculous quote by a DNA spokesman when interviewed about Hiroshima and Nagasaki veterans. He comments, "These guys are getting old enough so that they're just getting sick from being on the good old earth. Somebody has convinced them to blame it on radiation." A dumb answer from a supposedly intelligent person.

My husband was 54 years old when he died and certainly "not old". He was robbed of a good life. He was "just not getting sick". He had been sick since his discharge but unable to find a doctor to diagnose his illness until his bones began to break. He had been at Nagasaki 9 months. These men were not all moved in and out of the contaminated areas every 6 weeks as the DNA has reported. Ingested low-levels of radiation over a long period poison and destroy the cell mechanism. Radiation is known to produce mutations in cells. Constant low-levels hasten the process of changes and lead to early ageing.

Page 17 of the DNA report states that the occupation forces did not cleanup at Hiroshima and Nagasaki. This is contradictory to the veterans interviewed and it is also contradictory for the DNA because further in the report, it is stated that in some cases, U.S. occupation forces had to repair a specific building for interim use, make an airfield operational or clear a specific road for access. But they did not clean up? They were using trucks, bull dozers, heavy equipment to cause a dust bowl of radioactive particles. They disposed of weapons, ammunition, military equipment - but they did not clean up?

In June 1979 I listened while a New York Times journalist interviewed James J. McDaniel, a U.S. Marine, quartered in a bombed-out waterfront hotel. McDaniel drove a dump truck to help clean up the rubble from the moonscape that had once been a city - Nagasaki. He remembered, "It was cold. There were puddles and frost on the ground. I helped pick up metal and the metal felt warm in my hands. Bricks turned to powder." This was late September 1945. Jack said, "No one even mentioned radiation to us - they told us the atomic bomb had made a mess - - and it was." McDaniel was dying from Waldenstrom's macroglobulinemia, a rare cancer of the bone marrow in which blood protein is over-produced. His VA claim for service-connected disability was denied.

The DNA admits the movement of military personnel in the contaminated areas is a major source of uncertainty. It was not always known how many men there were, where they went and how long they stayed. The specific billet locations of all units of the divisions could not be precisely located - - but the DNA was sure they were well clear of the hypocenter. This is not true. The 6th. regiment was not billeted at Oura and Kamigo Barracks, as per the DNA. My husband was with the 6th. regiment and he was in a bombed-out warehouse, less than a ½ mile from the epicenter. Other marines were billeted in bombed-out school houses, close to the epicenter. Without correct information, without facts - how can the FACT SHEET be used for the denial of claims?

Page 24 - "Because we cannot track the exact movement of every individual for each day he was in Japan, one makes assumptions about movements, assignments, living patterns, etc." That is one truth the DNA makes. Again we find it to be a report of assumption and not fact.

The "quick look" radiation surveys by Manhattan District Scientists under General Farrell on 9/13 and 9/14/45 served the critical important purpose of allowing occupation plans to proceed. Not until 10/3 to 10/6/45 were more readings taken at Nagasaki, when our troops were already in the radiation area. Geiger counters were used for measuments. There are dangerous materials, which are not detectable on Geiger counters, notably PLUTONIUM remnants. Plutonium is a deadly substance, not biodegradable, with a life of 240,000 years. It is one of the most carcinogenic substances known. Plutonium is a chemically reactive metal and if it is exposed to air, it ignites spontaneously to produce respirable particles of plutonium dioxide. These particles can be transported by atmospheric currents and inhaled. When lodged in the lungs, plutonium particles bombard surrounding tissue with alpha radiation. The smaller particles are absorbed through the lung and

and enter the blood stream. Just one ingested particle would make a likely cancer candidate of any occupation veteran. Is it any wonder that Hiroshima and Nagasaki veterans suffered for many years from undiagnosed debilitating health problems and have died horrible deaths from Multiple Myeloma, Waldenstrom's Macroglobulinemia, Leukemia, Malignant Lymphoma, Factor III and other terminal blood cancers?

At the Trinity Site at Alamogordo, New Mexico, visitors are handed brochures 38 years later which read: "You should not eat, drink or smoke in the fenced area since there could be a potential hazard from ingesting small radioactive particles you may have picked up inadvertently." Still the Hiroshima and Nagasaki veterans were not warned of these hazards only a few weeks after the detonations.

The original readings by the Old Atomic Bomb Casualty Commission, now known as the Radiation Effects Research Foundation, are questionable. Japanese research of radiation victims was halted by Allied Occupation policies in Nov. 1945. For six years follow-up studies of A-bomb damages were forbidden and publication of their findings seriously curtailed until the San Francisco Peace Treaty in 1951.

A detailed study released in 1979 by Dr. Ikuro Ansai, Tokyo University, Professor and Sec. General of the 10,000 member of Japanese Scientists Assoc. states, "Though by my calculations the external exposure would have been relatively small, the internal radiation dose received by the bone marrow of U.S. Marines could have been exceedingly high. This was due to plutonium deposited in the water and soil at Nagasaki." (Bone marrow is extremely sensitive to radiation.) Dr. Ikuro Ansai's concern was with alpha radioactivity.

In Oct. 1980 at a medical meeting in Tokyo, the United Press International reported that 35 years after the atomic bombing of Nagasaki, large amounts of deadly plutonium still lied buried under the city according to Prof. Shunso Okajima. Radioactivity levels in the Nishiyama district, where the water reservoirs for Nagasaki were located, were far higher than expected and 76% of the plutonium was concentrated within 4 inches of the surface.

In 1981 Lawrence Livermore Laboratory researchers questioned the early readings which resulted in revisions. In June 1982 the British Journal of Epidemiology and Community Health reports residual radiation effects of the U.S. atomic bombings at Hiroshima and Nagasaki were seriously underestimated.

Recent disclosures from the National Archives of once classified material now reveal that the Manhattan Engineering District Scientists found low-level radiation at Nagasaki over 10 times the radiation safety standard for the general public. This definitely points to a cover-up.

Last year the Japanese translated into English a comprehensive survey indicating the long term effects of radiation exposure - the physical, medical and social effects of the atomic bombings. In the Fall of 1981 the National Academy of Sciences released a statement that studies of Japanese, who had earlier and more prolonged exposure to the areas, showed no increase in cancer mortality. This statement was in direct contradiction to the Japanese statement dated Aug. 6, 1981, which revealed that among their current medical findings an irreversible injury remained in cells, tissues and organs, leading to such blood disorders as leukemia, multiple myeloma, malignant lymphoma and other serious diseases.

For 6 years I have researched information on Hiroshima and Nagasaki veterans. I have received 3 death benefit denials from the VA. In March 1981 I appeared before the Washington, DC Board of Appeals - my appeal was denied in July of that year. Then in February 1982 after writing a strong letter to Robert Nimmo, then VA head, my appeal was reopened "because of possible error". I found this rather humorous but it was a ray of hope only to be again denied in June of 1982, for lack of persuasive evidence. My persuasive evidence is a dead husband - one who had been exposed to radiation during his service in Nagasaki. The VA nor the DNA have proof that his illness and death were not related to his service. The information upon which the pattern of denials for atomic veterans is based is pure assumption and indeed questionable.

The VA is shielded by their very ancient law, which prevents justice for the atomic veteran and it must be changed. Radiation is a silent invader, a silent killer. Atomic veterans receive radiation damage while in the service of their country but because their problems may not surface for years, they are denied compensation. The VA has used this law to deny my claim and every other atomic veteran's claim. The burden of proof needs to be shifted back where it belongs - from the veterans and widows to the government. Veterans are sick and dying and widows are struggling to raise their families without assistance. We are not seeking any special favors - - only justice. Justice based on true facts - not on estimations and assumptions. We desperately need our Senators, our Congressmen and our House Veterans Affairs Committee to help us obtain the justice due us.

Most sincerely,

Jean Ralph

Jean Ralph, Atomic Widow
RFD #5
Streator, Illinois #61364

May 24, 1983

TO: Committee on Veterans Affairs
United States House of Representatives

FROM: Dr. Edward A. Martell, National Center for Atmospheric Research,* P. O. Box 3000, Boulder, Colorado 80307

SUBJECT: Prepared Statement on Radiation Exposure Levels and Delayed Health Effects Experienced by Atomic Veterans

I am submitting prepared testimony at the invitation of the National Association of Atomic Veterans to speak on behalf of Atomic Veterans who have been incapacitated by delayed radiation health effects, and the dependents of deceased Atomic Veterans. I appreciate this opportunity to present my views on radiation exposure levels and on the health effects attributable to such exposures experienced by many Atomic Veterans. My comments are directed mainly to the more serious shortcomings of the proposed regulations of the Veterans Administration regarding claims based on ionizing radiation exposure, described in Federal Register notice, page 47062, October 27, 1982.

1. Inadequate Radiation Exposure Records:

Film badge records of radiation exposures are inadequate in several important respects. Many personnel were not badged--in some instances only one member of a platoon (about 35 men) wore a badge. Film badge readings were inaccurate and also provided no measure of the higher radiation doses to the extremities (hands and feet) due to β^- radiation. Radiation dosage reconstruction is unreliable guess work, mainly because individual members of a group may have received a radiation dose as much as 5 to 10 times higher than the average dose for the group.

---

*Affiliation given for address purposes only.

Film badge records also are incomplete and some records were mislayed or lost. My own experience illustrates the inadequacies of record keeping. I was a Lieutenant Colonel in the Army Corps of Engineers, with a Ph.D. in radiochemistry, when I served on the staff of the Armed Forces Special Weapons Project (now the Defense Nuclear Agency). I took part in four nuclear test series, as follows: Buster-Jangle, Nevada, fall 1951; Tumbler-Snapper, Nevada, spring 1952; Upshot-Knothole, Nevada, spring 1953; and Castle, Enewetok and Bikini, spring 1954. The first DNA search for my film badge exposure records was very incomplete. A second search turned up additional exposure records, but none for my participation in the 1953 Upshot-Knothole tests. If exposure records are incomplete even for fairly senior members of the nuclear weapons testing staff, how much worse must the situation be for the Atomic Veterans at Camp Desert Rock who participated in large numbers (many unbadged) as close-in observers and in post-shot military maneuvers at atmospheric nuclear tests in Nevada?

Alan Favish (ref. 1) has pointed out that "There was no central records depository for troops who participated in atomic maneuvers. Furthermore, in 1973 a fire in a government building destroyed millions of military personnel records. Thus, many veterans are now finding it extremely difficult, if not impossible, to prove that they attended a nuclear blast. Those who can prove their attendance are finding it equally difficult to prove the dosage level of radiation to which they were exposed." As Favish pointed out (1), government agencies are clearly at fault for inadequate records of radiation exposures and even of nuclear test participation by Atomic Veterans.

2. Internal Radiation Exposures:

In section 3.163(a)(5) of the proposed VA regulations, it is admitted that exposure records, based on film badge measurements, provide no measure of dose commitments due to inhaled or ingested radioactivity. It also is stated, "All research and analysis to date indicate that there is little likelihood that test participants inhaled or ingested any significant amounts of radiation." This is an unsupported and highly unjustified claim! Military personnel participants were exposed to the inhalation of radioisotopes, including alpha and β^- emitters, at exposure levels which could give rise to significant risks of lung cancer, bone cancer, leukemia, and other effects. The most important radioisotopes involved included plutonium-239, americium-241, and strontium-90. Soil surfaces in the nuclear test area were heavily contaminated by each successive nuclear explosion, and contamination levels for long-lived radioisotopes became progressively worse throughout the period from 1951 to 1962 during which a total of 166 atmospheric nuclear tests were conducted in Nevada. A tabulation of the dates, code names, energy yields, and other details of U.S. nuclear detonations appears in the AEC Health and Safety Laboratory Report No. HASL-142, January, 1964 (ref. 2).

The 1951 Jangle tests involved two nuclear cratering shots, one detonated at the ground surface and one at a shallow depth underground. The two craters, crater lips, and their environs, and large areas northeast of each crater, were heavily contaminated with radioactive fission products and transuranium elements. Military personnel marching through such areas, digging foxholes, inhaling dusts from passing vehicles, etc., were variously exposed to the inhalation of radioactive isotopes, some known to be very effective agents of cancer and leukemia. No monitoring or measurement was carried out to assess possible inhalation exposure to contamination from previous tests as well as to fresh radioactive fallout from some of the observed nuclear explosions. Dust respirators were not provided. Gas masks were sometimes carried but rarely worn.

For these reasons it is not at all surprising to find serious health effects among atomic veterans whose film badge records indicated low radiation exposure levels. Internal radiation exposure due to inhaled fallout particles may very well explain the excess incidence of many of the delayed health effects, including cancers, leukemia, premature aging, atherosclerosis, sclerotic diseases, and other chronic health effects and genetic effects which have been experienced by many Atomic Veterans and their children.

One straightforward approach to an assessment of internal emitter exposure levels in possible radiation victims among deceased Atomic Veterans would be the analysis of skeletal tissue for strontium-90, plutonium-239, americium-241, and other bone-seeking radioisotopes. Results should be compared with the bone concentrations of these radioisotopes in age-matched, unexposed members of the general public as controls.

3. Delayed Effects of Radiation

The late somatic effects of radiation exposure identified in section 3.163(b)(2) of proposed VA regulations lists only leukemia and a few common types of cancers as effects which show strong associations. However, it is well-established in the published scientific literature that the delayed health effects of ionizing radiation include premature aging, atherosclerosis, sclerotic diseases, and genetic effects. Premature aging effects include damage or loss of sight, hearing, memory, sensation, and the like. Radiation-induced atherosclerosis, well-established, is expressed by the early incidence of coronaries, strokes, and the whole spectrum of cardiovascular diseases. Sclerotic effects include eye cataracts, optical neuritis, partial paralysis, loss of sensation, loss of muscular control, and other effects attributable to whole body radiation and damage to the central nervous system.

Many aspects of delayed radiation effects that can be expected from exposure to nuclear explosions and radioactive fallout are discussed in the testimony of K. Z. Morgan and E. A. Martell in the February 18, 1981 hearings before the Veterans Administration Board of Appeals (ref. 3). Some of the published evidence which indicates that ionizing radiation, particlarly internal alpha emitters, may be important factors in the etiology of atherosclerosis is discussed and documented in publications by A. Elkeles (ref. 4) and E. A. Martell (ref. 5).

4. Cancer Risks:

The proposed VA regulations, section 3.153(b)(2)(vii), cite the Work Group on Care and Benefits of the Interagency Task Force on Ionizing Radiation (ref. 6), and suggest that, among the 200,000 nuclear test participants exposed to an average radiation dose of about one-half rem, there would be only 10 additional fatal cancers, compared to the 32,000 cancers due to "natural factors" that would be expected over the lifetime of the entire group. This estimate is poorly based on inadequate film badge exposure records and on other highly questionable assumptions. Bross and Driscoll (ref. 7) estimate an added 19 lung cancer deaths, plus other cancers and other causes of death--not just 10 lethal cancers of all types--for 100,000 man-rem of radiation exposure to Atomic Veterans. Authors of the proposed VA regulations failed to take note of the very serious implications of the Hanford and Tri-State studies which indicate that "background radiation may account for between 50 and 70 percent of all cancer, instead of the one percent predicted by current assumptions" (ITF ref. 6, page 49).

Internal radiation exposure to inhaled and ingested alpha and β^- emitting radioisotpes, not considered by the ITF, also can give rise to a very much higher incidence of lethal cancers in this group of 200,000 Atomic Veterans. The National Cancer Institute has repeatedly stated that about 90 percent of human cancer--28,800 of the 32,000 cancers expected due to "natural" factors in this group--can be attributed to environmental agents, but has not yet identified the specific agents involved. It is likely that many of the cancers which are due to "environmental factors" result from radiation exposure to indoor radon decay products in the home and the workplace--to cumulative internal alpha radiation exposure. For example, it is now evident that the high incidence of lung cancer in cigarette smokers--the leading cause of cancer deaths among men and second leading among women--can be attributed to a large alpha radiation dose in small tissue volumes in the lungs of smokers (ref. 8). Atomic Veterans were subjected to the inhalation of plutonium-239 and other alpha emitting radioisotopes. Such exposure could give rise to a much higher incidence of leukemia and cancer deaths, as well as to a much earlier incidence of many of the 32,000 cancers "normally" expected in this group of 200,000 veterans. As noted above, measurements of bone-seeking radioisotopes such as plutonium-239 and strontium-90 in the skeletal tissue of deceased Atomic Veterans would provide important insights on internal radiation exposure levels in this group. Such measurements would be an important part of any adequate medical follow-up of delayed health effects attributable to ionizing radiation exposure.

5. General Comments:

The Interagency Task Force on Ionizing Radiation has admitted that the late or delayed somatic effects of ionizing radiation are very incompletely understood and that ongoing and future research will be needed to provide a more definitive listing of the late somatic effects of low-level ionizing radiation. It also should be noted that the relative importance of ionizing radiation in the form of internal alpha and β^- emitters, vs chemical carcinogens, in the etiology of the normal incidence of cancer and atherosclerosis has not yet been adequately assessed. An objective evaluation of all serious health effects experience by Atomic Veterans, and the age distribution as well as the excess incidence of such effects, will shed considerable light on the delayed effects of ionizing radiation. Denials that unusual and rare health effects suffered by Atomic Veterans are attributable to radiation exposure are poorly based and unjust. It is overdue that the Veterans Administration and other federal agencies face up to the fact that our Atomic Veterans were, in effect, used as guinea pigs. In all claims for health care and compensation, the Atomic Veterans deserve and should be given the benefit of any doubts--not the burden of proof. A well-documented and persuasive case for transferring the burden of proof from radiation victims among Atomic Veterans and their surviving dependents to the Veterans Administration has been provided by Alan Favish (ref. 1).

6. References:

1. Alan Favish, "Radiation Injury and the Atomic Veteran: Shifting the Burden of Proof on Factual Causation," The Hastings Law Journal, Vol. 21, pp. 1-41, 1979.

2. U.S. Atomic Energy Health and Safety Laboratory, Report HASL-142, Part III, "Announced Nuclear Detonations, 1945-1962, United States, United Kingdom, Republic of France, Union of Soviet Socialist Republics," pp. 218-242, January 1, 1964.

3. Albert Bates, "Proof of Radiation Injury," Hearings before the Veterans Administration Board of Appeals, Docket No. 80-26532, February 18, 1981, Published by The Natural Rights Center, Summertown TN 38483, 1981.

4. Arthur Elkeles, "Metabolic Behavior of α-Ray Activity in Large Human Arteries: Relationship to Atherosclerosis," J. of American Geriatrics Society, Vol. 25, No. 4, pp. 179-182, 1977.

5. Edward A. Martell, "Tobacco Radioactivity and Cancer in Smokers," American Scientist, Vol. 63, pp. 404-412, 1975.

6. Interagency Task Force on Ionizing Radiation, Summary of Work Group Reports, Dept. of Health, Education and Welfare, February 27, 1979.

7. I. D. J. Bross and D. L. Driscoll, "Direct Estimates of Low-Level Radiation Risks of Lung Cancer at Two NRC-Compliant Nuclear Installations: Why Are the New Risk Estimates 20 to 200 Times the Old Official Estimates?" The Yale Journal of Biology and Medicine, Vol. 54, pp. 317-328, 1981.

8. E. A. Martell, "α-Radiation Dose at Bronchial Bifurcations of Smokers from Indoor Exposure to Radon Progeny," Proc. Natl. Acad. Sci., Vol. 80, pp. 1285-1289, March 1983.

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"Ivy"
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Warren, Mass. 01083
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May 9, 1983

Honorable G.V. (Sonny) Montgomery
Committee on Veterans' Affairs
House of Representatives
Room 2184 Rayburn Building
Washington, D.C. 20515

Hearing, House Committee on Veterans' Affairs:

Dear Representative Montgomery:

The purpose of this letter is to relate doubtful findings in the research and reconstruction of events during Operation IVY. On November 1, 1952 at Eniwetok Atoll, Pacific Ocean, the United States exploded a hydrogen device with the weapon yield of 10.4 megaton'. All military and civilian members witnessed this MIKE shot while aboard ships and other vessels that sailed the southern waters of Eniwetok. Other ships were in patrol duty patterns in circumference to this proving grounds area. At 7:15am local time, this surface test was detonated on the northern rim of the Atoll. Very little information has been released through declassified material other than what has been mentioned above.

After almost 30 years after this event veterans' have documented thier involement as to the duty they performed at Eniwetok. As members of the National Association of Atomic Veterans thier writings are parallel in remembrance of this operation.

These NAAV members have received parallel-like answersc with respect to records of radiation dose'they requested. The most often received reply is " No record as the information requested was destroyed in a fire" or "Your recorded radiation dose was below minimum level allowed".

Contained in a printing of the "History of USS Arikara ATF-98" (5-82) The mention of "Navy data does not indicate what kind of radiation readings were found onboard Arikara", while the destroyers USS Radford and USS Fletcher instantces of 3 to 4 mr/hr gamma.were reported. since this fallout was in excess of that allowed to give ships a final radiological clearance, the ships were monitored to determine where radiation levels were in excess of 0.6 mr/hr. It further states that after washing down contamination the ships contamination was brought below o.6 mr/hr. The crew members did not wear protective gear, most were barefoot during wash down. The one hour exposure time does not bear truth in this HISTORY document.

During the early afternoon of November 1, 1952 members of the Transportation detatchment - 4th Truck Co.Army,were returned to Eniwetok via landing craft for the purpose of setting up the tent area's before the main party of military would arrive. This group of men have documented what they experienced as the tents were untied, refolded and secured. Within a few houre most felt weakness to the point of falling to thier knees, followed by nausea. This physical problem was reported to the leaders of this work detail as it became epidemic with these troops. The officer in charge arrived to see what was occurring. Within moments this officer brought the rad-monitor team to check radiation levels in the area that these men were and had worked in. A short time passed when, "shouting and arms waving a rad-monitor officer that was on the verge of panic, ordered every man away from this tent-city. His remarks were this canvas is HOT". By mid afternoon on November 2, 1952 all military returned to thier living areas on Eniwetok.

November 16, 1952 a 500 kiloton atomic weapon was exploded via an air drop. All members of the task group remained on Eniwetok sat on the road or beach on the lagoon side for this KING shot. After the shock wave passed we were told we may stand and turn to view this detonation. Veterans recall the contrast of sky of blue with the off white mushroom cloud below.Ddocummatation tells also of the rain that fell from the manmade cloud within a short period of time of explosion. No warning or order was given to take cover during this downpour of rain.

On Parry Island that is east of Eniwetok by a few miles, civilian contractors, scientific people and military men were subjected to the rain from KING. High radiation was recorded. The men of science were very anxious to warn those that were out in this rain that the level of radiation was increasing at and to a very dangerous degree.

An Airforce B 29 equipped with recording and sampling devises was ordered parked at an isolated section of the airstrip on Kwajalein Island for several days. The crew of this aircraft flew through the cloud of the KING test. Care was a concern to make sure the B 29 remained OFF LIMITS. The flight crew did not afford any concern.for thier contamination.

The text of this communication is a summary of events that only expresses what atomic veterans have witnessed and have documented. The depth of the eyewitness accounts of operation IVY are many.

Let me state that all nuclear test operations are unique. Fact of the true events shall be furnished by the atomic veteran. This segment of patriots' are obligated to this end.

In closing I wish to refer to the plight of the atomic veteran and the families of atomic veterans. The quote I will write shows the cold expression of an agency of our Nation.
Veterans Administration News Release on April 14,1983 page 2 line 15.

"As of March 1,1983, veterans who had filed claims for VA compensation based on radiation totalled 3,325. Only 2,321 of the claimants exhibited any medical condition requiring medical treatment."

The word only is the cold expression. Hot is my feelings... I am a veteran of Operation IVY.

Sincerely,

William R. Dolan

William R. Dolan
Reconstruction Coordinator "IVY"

ANALYSIS.

Defense Nuclear Agency Report 6028F

PROJECT TRINITY
1945 - 1946

A Report for the National Association of Atomic Veterans

by

Rocco P. Agostini

This report has been compiled at the request of the National Association of Atomic Veterans (NAAV). It is hoped that the facts contained herein will aid all veterans with medical problems caused by government atomic testing.

Project Trinity was the first successful detonation of an atomic weapon. The Defense Nuclear Agency (DNA) Report 6028F, Project Trinity 1945 - 1946, details events before, during and after detonation. Certain passages within this report are inconsistent with accounts of eye witnesses to the event and individuals closely involved with Project Trinity.

For example, the DNA report states that the Trinity site monitoring group was responsible for equipping test personnel with protective clothing and test measurement equipment.[1]

A participant in the project who was stationed at the site base camp was issued only a helmet liner, smoked glasses and a blanket; his test equipment consisted of a filmed badge that was carried in his fatigue jacket pocket. This individual, Bill E. Willoughby, is now suffering from cancer of the larnyx. Mr. Willoughby was assigned to Company B, 9812th Technical Service Unit, Corps of Engineers, U. S. Army.

The DNA does state in its report that full length protective clothing, including booties and respirator, was issued after the test.[2]

The DNA report notes that four teams were deployed to distant positions to monitor the blast. Two teams were stationed to the east of the Trinity site at Nogales and Roswell, N. M. Another team was deployed to Socorro, N. M. to the northwest. The fourth team was stationed at Fort Sumner, N. M., northeast of Trinity.[3]

No off-station monitoring teams were stationed to the southeast, south, southwest or west to monitor the blast effects and radiation levels.

Bad weather complicated the already unpredictable nature of this first step into the age of atomic weapons. The weather included rain, thunderstorms and generally poor flying conditions at the test site and at Kirtland Field, N. M.[4]

A B-29 Superfortress was launched from the air base to monitor the test. An observer in the aircraft during the detonation noted that variable winds tore the clouds into three distinct sections that drifted in different directions.[5] Another account of the blast notes that after air containing fission products reached the southern base camp, the contaminated air was carried southward by natural breezes flowing down the valley.[6]

Two miscalculations by the head of the Manhatten Project accounted for a dramatic increase in the amount of radioactive material that was generated and distributed throughout the Southwest. Maj. Gen. Groves estimated that the weapon would produce the destructive force equivalent to 250 to 500 tons of TNT. The actual force was estimated at 20,000 tons of TNT.[7]

The actual force was so great that the War Department, in a news release, described a "heavy pressure wave which knocked down two men outside the control tower (10,000 yards, or more than five miles, away)".[8]

The second error was placing the nuclear device only 100 feet above the desert floor. The military hoped to wreak as much havoc as possible on the Japanese through a nuclear air burst. The War Department hoped to expend atomic energy through the air to create violent winds and a huge fire ball. The Department did not envision creating excessive radioactive debris with a ground burst. What, in fact, was produced at Trinity was a 1200 foot wide, 25 foot deep bowl in the desert floor.[9] Tons of radioactive dust particles were distributed throughout the southwestern United States.

The Trinity and the Nagasaki devices were virtually identical. The latter, detonated at 2,000 feet above ground level, destroyed an entire city and killed approximately 75,000 people. The Trinity device exerted much more of its force to create a huge, unplanned crater and associated radioactive dust particles.

Clearly, there are inconsistencies in the Project Trinity report. These inconsistencies, coupled with pre-atomic age miscalculations, were responsible for the pain and suffering of many armed forces veterans.

References

1. Defense Nuclear Agency, Report 6028F, Project Trinity, 1945 - 1946 (December 15, 1982), p. 2.

2. Ibid., p. 33.

3. Ibid., p. 47.

4. Lansing Lamont, The Day of Trinity (New York, Antheneum, 1965), p. 217.

5. Ibid., p. 242.

6. Leona Marshall Libby, The Uranium People (New York, Charles Scribner's Sons, 1979), p. 228.

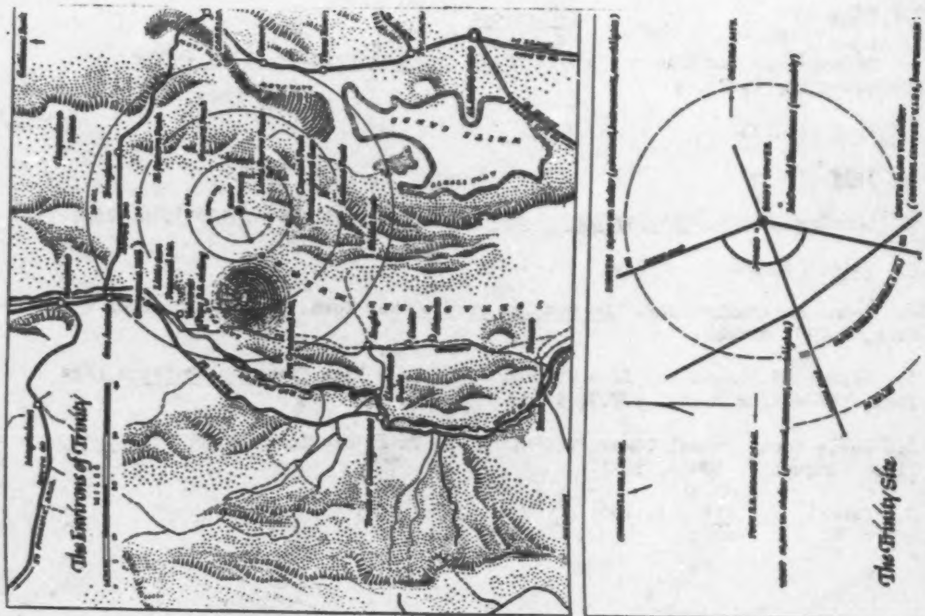
7. Richard S. Lewis and Jane Wilson, Alamogordo Plus Twenty-Five Years (New York, The Viking Press, 1970), p. 53.

8. Lewis Wood, "Steel Tower 'Vaporized' in Trial of Mighty Bomb," New York Times (August 7, 1945), p. 1.

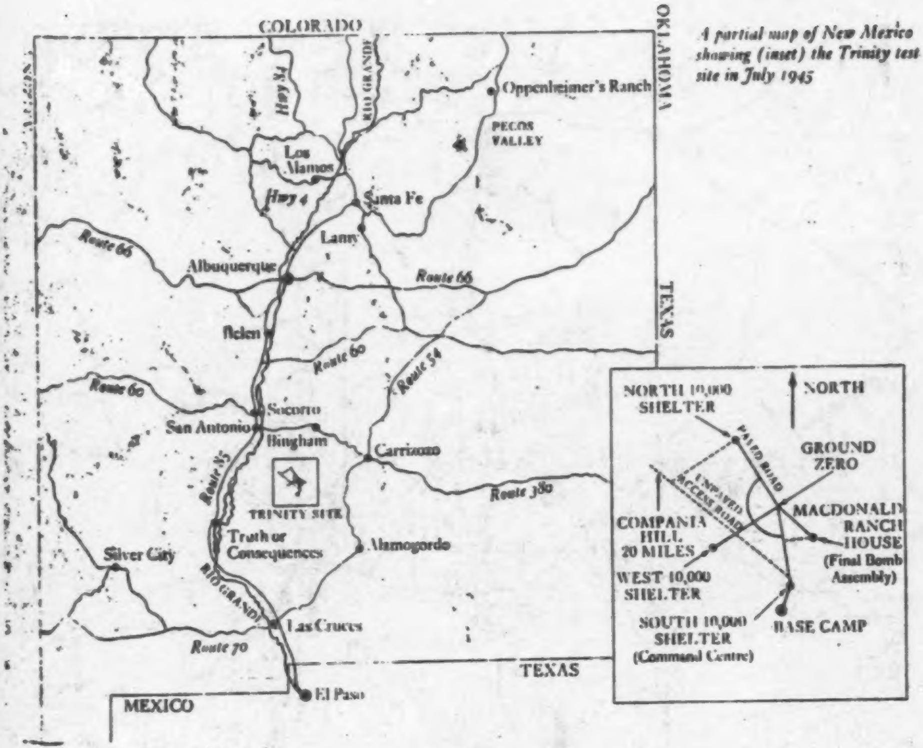
9. Lamont, op. cit., p. 246.

5 Attachments

1. Four maps describing Trinity Site location within the United States.
2. Partial map of New Mexico showing Trinity Test Site.
3. Map of New Mexico showing off-station test monitoring positions.
4. Trinity Site and Major Installations.
5. Honorable Discharge (copy) of TSgt Billy E. Willoughby.


The Environs of Trinity
MILES
The Trinity Site
Southwestern New Mexico
MILES
NEW MEXICO
TEXAS
UNITED STATES
MEXICO

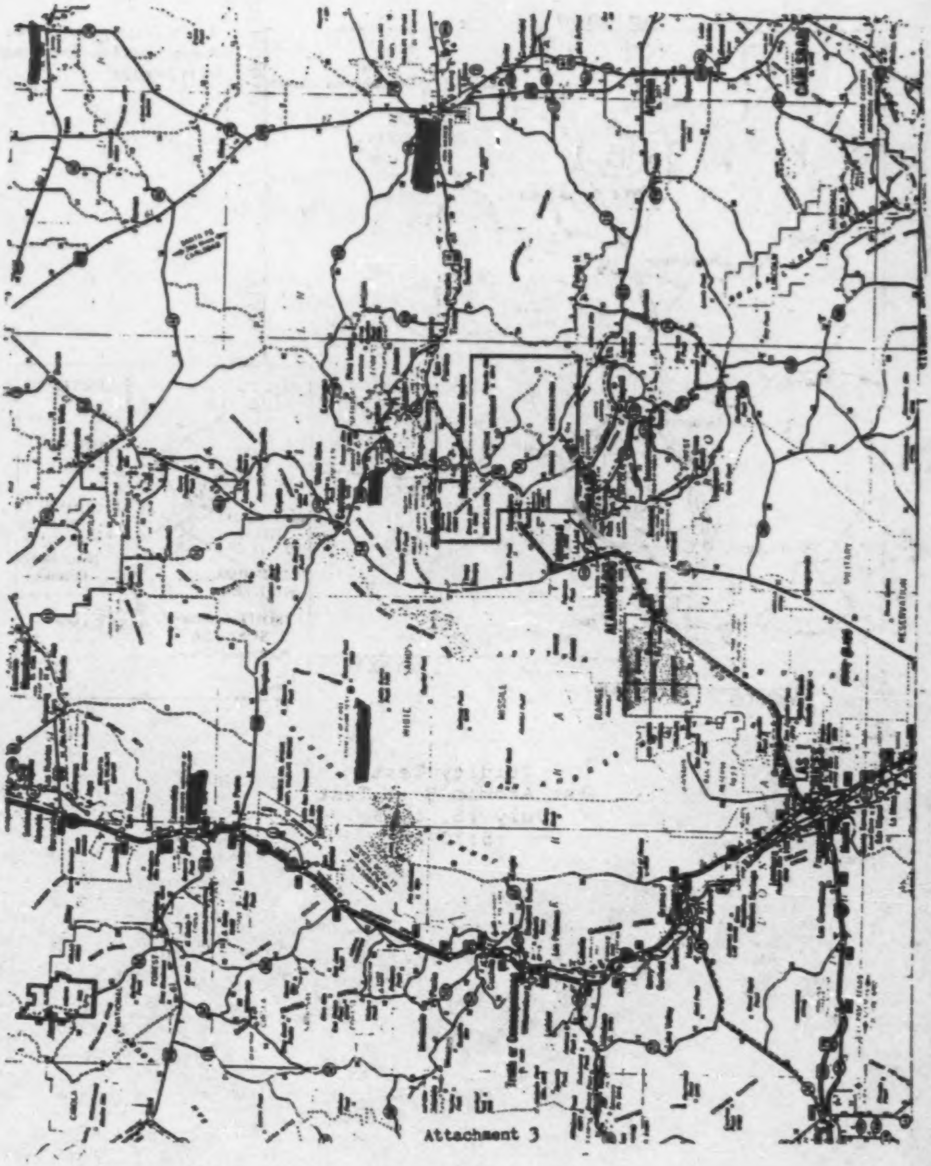
Attachment 1


COLORADO
OKLAHOMA
TEXAS
MEXICO
Hwy 84
RIO GRANDE
Oppenheimer's Ranch
PECOS VALLEY
Los Alamos
Hwy 4
Santa Fe
Lamy
Route 66
Albuquerque
Belen
Route 60
Route 54
Socorro
San Antonio
Bingham
Carrizozo
Route 85
TRINITY SITE
Route 380
Truth or Consequences
Alamogordo
Silver City
Las Cruces
Route 70
El Paso
NORTH 10,000 SHELTER
NORTH
GROUND ZERO
PAVED ROAD
UNPAVED ACCESS ROAD
COMPANIA HILL 20 MILES
MACDONALD RANCH HOUSE (Final Bomb Assembly)
WEST 10,000 SHELTER
SOUTH 10,000 SHELTER (Command Centre)
BASE CAMP

A partial map of New Mexico showing (inset) the Trinity test site in July 1945

Trinity Test
1st Atomic Bomb Test
July 16, 1945
5:30 AM

Attachment 2


CARLSBAD
MILITARY
RESERVATION

Attachment 3

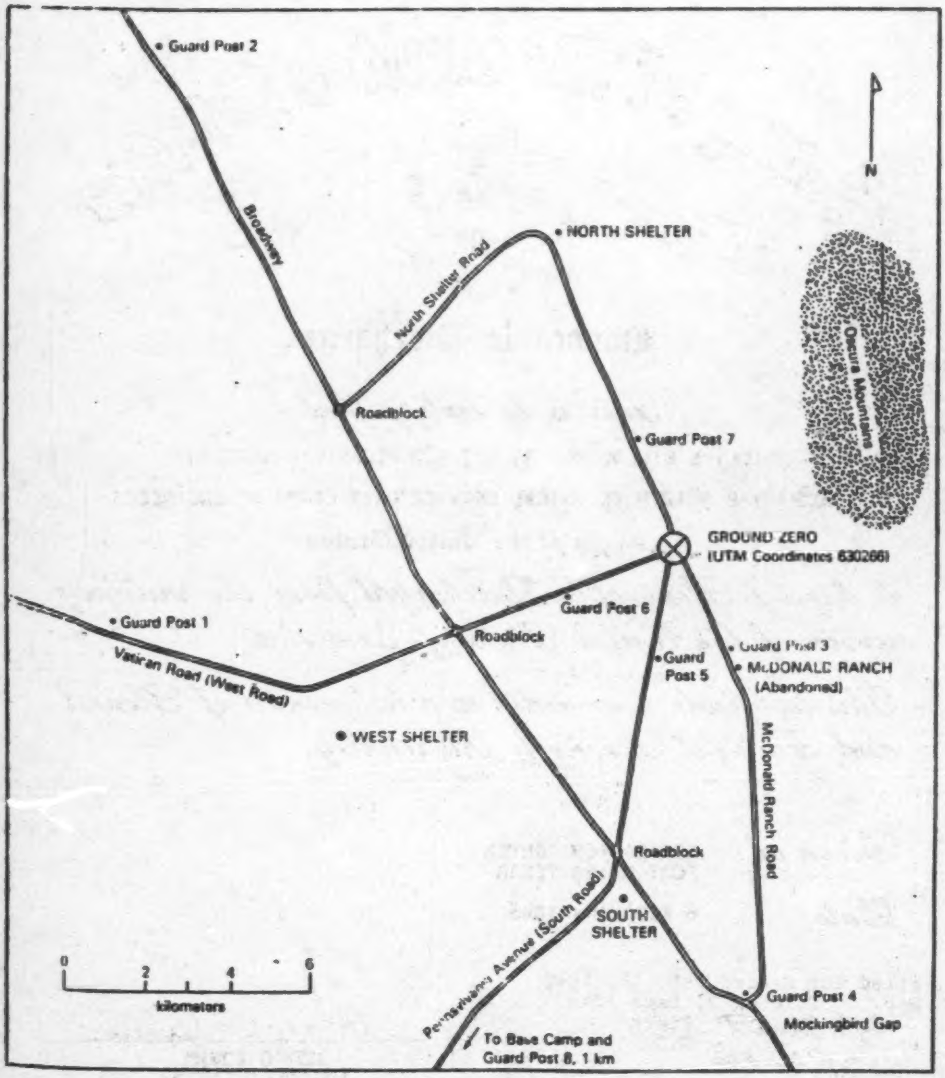
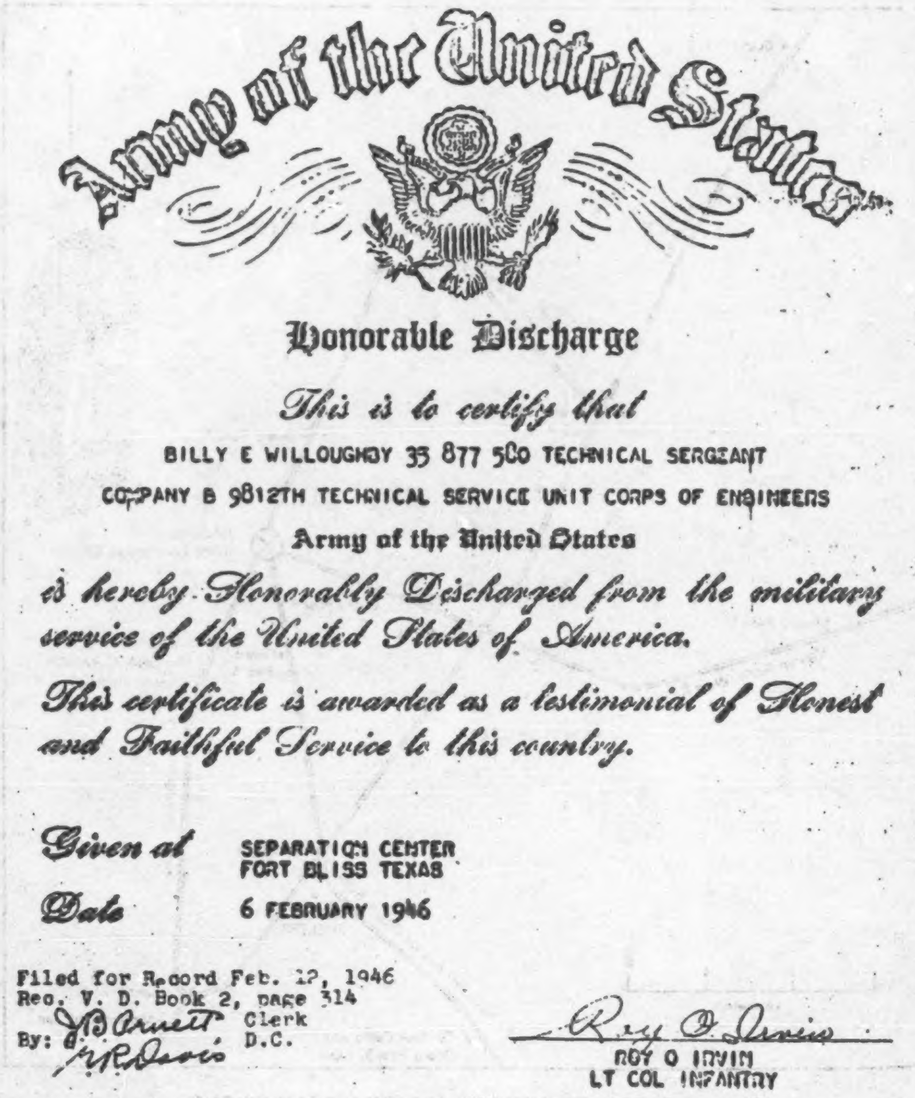

Guard Post 2
Broadway
N
NORTH SHELTER
North Shelter Road
Oscura Mountains
Roadblock
Guard Post 7
GROUND ZERO
(UTM Coordinates 630266)
Guard Post 6
Guard Post 1
Roadblock
Guard Post 3
Guard Post 5
McDONALD RANCH
(Abandoned)
Vatiran Road (West Road)
WEST SHELTER
McDonald Ranch Road
Roadblock
SOUTH SHELTER
Pennsylvania Avenue (South Road)
0
2
4
6
kilometers
Guard Post 4
Mockingbird Gap
To Base Camp and
Guard Post 8, 1 km

Figure 1-2: TRINITY SITE AND MAJOR INSTALLATIONS

Attachment 4



Army of the United States

Honorable Discharge

This is to certify that

BILLY E WILLOUGHBY 33 877 560 TECHNICAL SERGEANT

COMPANY B 9812TH TECHNICAL SERVICE UNIT CORPS OF ENGINEERS

Army of the United States

is hereby Honorably Discharged from the military service of the United States of America.

This certificate is awarded as a testimonial of Honest and Faithful Service to this country.

Given at SEPARATION CENTER
FORT BLISS TEXAS

Date 6 FEBRUARY 1946

Filed for Record Feb. 12, 1946
Rec. V. D. Book 2, page 314
J B Arnett Clerk
By: G R Davis D.C.

Roy O. Irvin
ROY O IRVIN
LT COL INFANTRY

Attachment 5

NATIONAL ASSOCIATION
OF ATOMIC VETERANS
1109 FRANKLIN STREET • BURLINGTON, IOWA 52601 • TEL: 319-753-6112

TESTIMONY OF C. C. STAIR

Synopsis of Scientific Directors Report "Operation Greenhouse"

Ref: Chapter 2.1; Dust Collectors to be used for collecting dust particles of fallout. Eighty-five were ordered, they came in without batteries. Batteries were obtained for 10 instruments after "DOG SHOT". According to announced U.S. NUC. TEST NVO-209, no yeild range was available.

Chapter 2.2; "DOG SHOT". Based on data from "Sandstone", no fallout was to occur. One hour and forty minutes after the shot, instruments in the Radiologist Safety Center were indicating radioactive fallout. The program director was notified, as the intensity increased the Radio Chem. section began a study on particle size. For more detailed information see chapter 2.1, dust collectors, they had none so how did they collect fallout particles? One hundred-twenty-five urine specimens were checked. If my memory serves me correctly there were 5000 plus men on the test. Were that few specimens sufficient, this is only 2.5 %. Chapter 2.2 also mentions the fact that if dust collectors would have been used the investigation of the fallout would have been facilitated.

Chapter 2.3; "EASY SHOT; On E plus 1 day fallout occured on Eniwetok, Parry, and Japtan. I was on Eniwetok but know nothing about it. The Navy had a boat crew that was suspected of deliberatly leaving thei film badges in the highly contaminated area so they would have high exposure levels. I question this. If the monitoring was of a safe magnitude the Radiological Survey Team could have proved this and no questions would have remained unanswered.

Chapter 2.4; "GEORGE SHOT"; The survey teams admitted that on both DOG and EASY SHOTS they may have goofed. So they changed procedures on "GEORGE SHOT" in that recovery operations were delayed until a radiological safety survey was conducted on the shot island. this was not done before so what was to keep the personnel from receiving large doses of radiation since not all recovery personnel had film badges? The docimeters were inadequate to give accurate data i.e. they were of the 200 MR range and they kept pegging out which means they were insufficient for this type of usage, also they only had a total of 100. Paragraph 2.9.1 says they should have had 300 or more. Paragraph 2.6.2.3 mentions that the fallout on "DOG SHOT" came as a complete surprise (we don't need complete surprises when lives are at stake). 2.6.11 paragraph D. ref: fallout from "DOG SHOT" on Eniwetok. Very little is known about radio-active particles. Paragraph E, shows that new methods are being used to obtain further information on the radio-active heavy particle content of the clouds, which to me translates, they don't know if the methods of testing are of any value.

Paragraph 2.8, Supply and equipment, mention is made of 15,000 film badges. Looking at Paragraph 2.7.4 and 2.7.3 there had to be at least 3,180 film badges issued which means the films could only be changed 5 times. If the fallout was dangerous for as high as 9 days after each shot and the films were changed daily they blew their supplies on "DOG SHOT". Also there were only 200 docimeters used this was grossly inadequate. See Paragraph 2.9.1

Paragraph 2.9 mentions the problems with humidity affecting the survey meters and docimeters. I know this was a problem and we had much humidity and salt air. I question the validity of good accurate instrument because of the moistue problem. I used these survey meters and docimeters for 6 years as an X-ray technician.

Paragraph 2.10, Dosage records. The writer admits to a trial and error system on the records. The way the photodosimetry section arrived at the dosage is pretty sloppy. Since they didn't have any standards for comparison of exposure. This is an acceptable way for all radiological data. The calculated curve is too broad a

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base for good exposure data, also the docimeters should all be read by a few technicians instead of allowing each individual to read and record results. If they are not competent they will record anything. There is a mention of many films being issued to one or more individuals. How did they accurately expose, date, and clarify data if several films were issued to one person ? There is a question of the validity of the film exposure system because of the lack of a list of names.

Paragraph 3.1 mentions the fact that responsibility for radiological safety assigned to individual task groups was in error. I mentioned basically the same thing above in paragraph 2.1

Summary;

It seems to me that all units were on a training mission because there were no provisions made for the safety of troops on the first shot, since the scientist didn't expect fallout. Apparently that is why our troop commanders didn't worry about protecting us. There is very little mentioned in the report about Eniwetok safety. I happen to know there was no safety check made in my section. No film badges, no docimeters and no survey meters. The report mentions Parry, Engebi, Rundt and many more islands but very little about Eniwetok. I don't understand this since the B-17 Bombers that flew through the blast and radio-active clouds landed on our airstrip. They were washed down and the radiation had to be in the water used for this purpose. It looks to me as if the scientists on Parry were looking out for their own well-being but cared little about the troops on Eniwetok.

Mr. C.C. Stair
2427 Eden Drive
Hagerstown, MD 21740

NAAV

NATIONAL ASSOCIATION
OF ATOMIC VETERANS

WASHINGTON OFFICE • SUITE 606, 236 MASSACHUSETTS AVENUE, N.E., WASHINGTON, D.C. 20002 • (202) 543-7711

PREPARED STATEMENT OF

GLENN H. ALCALAY

NAAV SCIENTIFIC AND MEDICAL ADVISOR

TO THE

HOUSE COMMITTEE ON VETERANS' AFFAIRS

MAY 24, 1983

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

It has been nearly four years since this Committee convened for hearings to investigate matters pertaining to the health and well-being of the approximately 250,000 ex-servicemen who partook in above-ground nuclear weapons experiments between 1945 and 1962. Since the time of the last hearing in 1979, many critical factors have emerged which have direct bearing on the question of the relationship between exposure to ionizing radiation and adverse health effects, especially in relation to those effects which have a latency period of several decades and beyond.

One of the most important discoveries in recent years centers around the interpretation of Japanese A-bomb studies. Most of the national and international scientific bodies conducting radiation research rely almost exclusively on these Japanese data, including the National Academy of Science's Biological

Effects of Ionizing Radiation (BEIR-3) Committee, as well as the Interagency Task Force on Ionizing Radiation, which the Veteran's Administration relies upon.

Another important development since the last Committee hearing is the finding by the Centers for Disease Control that ex-servicemen who witnessed the SMOKY atomic test in 1957 have a three to four-fold increase of leukemia as well as a ten-fold increase of a rare form of bone marrow disease similar to leukemia.

Finally, evidence has been mounting since the last hearing which suggests that low-level ionizing radiation--the type of radiation many of our former veterans were exposed to--causes many degenerative diseases besides cancer and thyroid nodules, including chromosome changes which can lead to sterility and birth defects among the children of atomic veterans. All of these aforementioned current scientific discoveries shall be expanded upon in the following sections.

CONTROVERSY OVER JAPANESE A-BOMB DATA

According to researchers at the Lawrence Livermore weapons laboratory in California and the Oak Ridge National Laboratory, some of the most important data on the effects of ionizing radiation on humans may be wrong. In an article in the May 22nd, 1981 issue of Science, a consultant who is working on this research said that the dose revisions "are moving in the wrong direction"--a direction that will cause great concern among the advocates of nuclear energy.

The importance of this new finding is that it completely changes the scheme of radiation doses which the Japanese bomb survivors are supposed to have received, especially in Hiroshima. The new research has revealed that most of the cancer caused by the atomic bombs came from gamma rays--and not from fast neutrons--suggesting that gamma radiation is much more hazardous than was previously believed. The film badges worn by some atomic veterans recorded only gamma radiation.

David Auton, a physicist in the office of target and damage assessment of the Defense Nuclear Agency (DNA)--and who accompanied General Harry Griffith at the April 6th Senate hearing--has stated his concern about the new findings with the Japanese A-bomb studies. In an interview in the May 22nd, 1981 Science, Auton stated, "The implications are far reaching for health regulation and nuclear power in this country in general."

More recently, Dr. Edward Radford, professor of environmental epidemiology at the University of Pittsburgh and former chairman of the BEIR-3 Committee, has sharply criticized the Japanese studies which serve as the basis for the National Academy of Science's BEIR-3 report. In a March 18th, 1983 New York Times article entitled "Health Expert Finds Hazard of Radiation Worse Than Feared," Radford said that the new research on the Japanese A-bomb victims shows that the radiation damage was ten times worse than previously indicated.

In conjunction with these recent developments in radiation studies, it should be noted that since at least 1978 the federal government has admitted that there is no known safe dose of ionizing radiation, no "threshold" level. This admission is found in a Nuclear Regulatory Commission document (July 31, 1978, SECY-78-415, Policy Session Item from Robert B. Minogue, Office of Standards Development) which urges that the term "permissible dose" be discontinued because it has been misinterpreted to mean "safe." Minogue, the author of this document, states that "Considerations of the linear hypothesis indicate that some risk is associated with any dose of radiation, however small."

THE CALDWELL "SMOKY" STUDY AND DR. ALICE STEWART'S RESEARCH

The most significant piece of scientific research to date is the government-sponsored Centers for Disease Control study of the 1957 SMOKY test participants by Dr. Glyn Caldwell. The Caldwell study is the only scientific study we have so far which has investigated a particular nuclear test, and the finding of this study has shown a statistically significant incidence rate of leukemia. In addition, an alarmingly high incidence rate of a very rare form of bone marrow disease similar to leukemia--polycythemia vera (PV)--has been identified among the SMOKY participants in conjunction with the leukemia finding. Both of these diseases are closely associated with exposure to ionizing radiation.

In the past month, a British epidemiologist has made the startling discovery that an abnormally high incidence of leukemia and other reticuloendothelial system (RES) neoplasms has occurred among British ex-servicemen who participated in nuclear weapons tests at Christmas Island in the South Pacific between 1957 and 1958. Writing in the April 9th, 1983 issue of the British journal Lancet, Dr. Alice Stewart states that she would have expected to find 17 cases of RES disease among the approximately 8,000 atomic veterans who served at Christmas Island. From a preliminary sample of only 330 returned questionnaires from the group of 8,000, Dr. Stewart has located 27 cases of RES disease thus far--a finding that suggests a dramatic incidence rate of RES disease in this population exposed to ionizing radiation. This recent finding by Stewart is a significant piece of the enigmatic puzzle surrounding the atomic veterans issue, and we shall be monitoring the progress of these British researchers as they attempt to unravel a portion of Cold War history by use of statistical techniques. Moreover, Stewart and her co-researchers in England are getting the full support of the scientific community in that country, as exemplified by the following statement which appears in the April 9th Lancet, and which was underwritten by a wide array of British scientists:

> The servicemen present at the nuclear test explosions constitute a uniquely large sample of healthy young men who were at risk of exposure to ionising radiation and among whom there now appears to be evidence of radiation related effects. To examine as fully as possible their subsequent medical histories, access to a complete nominal roll of the total group of exposed persons is required, together with full disclosure of what is known about radiation exposure of the men on duty during these tests. We urge that an independent academic body be asked to conduct a full investigation into the morbidity, mortality, and perhaps genetic effects in these men, and given the means to do so.

RADIATION EXPOSURE AND DEGENERATIVE DISEASES

In a 1975 study of physician radiologists (American Journal of Epidemiology, Vol. 101, No. 3, pp. 199-210), Matanoski, et al., found a significantly higher cancer and leukemia incidence rate among those physician specialists who were accidentally exposed to x-rays during treatment. This finding is important because x-rays are very similar to gamma rays, one of the types of radiation atomic veterans were exposed to.

In addition to cancer and leukemia, radiologists in the study by Matanoski developed a plethora of diseases having statistical significance, including diabetes, cardiovascular disease, stroke, and hypertension. Interestingly, Matanoski noted an age-related gradient in relation to the incidence of disease: there were more diseases among older radiologists than among younger radiologists. This, says Matanoski, is probably due to refinements in the x-ray procedure over the decades.

In another interesting and quite relevant study, Elkeles (Journal of the American Geriatrics Society, 1977, Vol. XXV, No. 4, pp. 179-82) discovered a close relationship between atherosclerosis and ingestion of alpha particles. Atherosclerosis is a form of arteriosclerosis in which fatty substances deposit in the inner walls of the arteries and can lead to cardiovascular disease and heart problems. The significance of the Elkeles study is that it demonstrates a significant causal link between ingestion of alpha radiation and cardiovascular disease. This is especially important in light of the fact that an untold number of the 250,000 atomic veterans ingested and inhaled varying quantities of alpha particles during the atmospheric nuclear weapons tests. What is particularly worrisome is the fact that because film badges were designed to only record external gamma (and x-) radiation, the internal absorption of alpha (along with beta, neutron, and gamma-emitters) may have been significant. The study by Elkeles would certainly warrant an investigation into the possibility that alpha particle ingestion may be responsible for an excess number of cardiovascular diseases among atomic veterans, especially in view of our preliminary findings which indicate an abnormally high incidence rate of heart problems among our atomic veteran members.

In a report issued by the International Atomic Energy Agency (IAEA) in 1978, a Japanese researcher has noted a major finding concerning cardiovascular disease among Hiroshima females. Writing in the "Proceedings of a Symposium on Late Biological Effects of Ionizing Radiation" (Volume I, Vienna, March 13-17, 1978), Dr. H. Kato has discovered a dose-response phenomenon with respect to cardiovascular disease in Hiroshima females: The rate of cardiovascular disease among the Hiroshima A-bomb survivors increases with dose of radiation. This is a truly significant finding in two regards: (1) Japanese women typically have a relatively low incidence rate of cardiovascular disease in the unexposed population, and (2) The new findings from the Hiroshima studies suggests that gamma radiation was responsible for more of the damage than was previously considered.

CHROMOSOME ABERRATIONS AND POSSIBLE GENETIC EFECTS OF RADIATION

Several studies among exposed populations have strongly suggested a direct link between exposure to ionizing radiation and chromosome and genetic damage.

As early as 1925 reports began to surface about the ill-effects associated with the ingestion of radium and other radioactive materials among the women who were formerly employed as luminous-dial painters. In a February 12th, 1966 issue of the British Medical Journal, J.T. Boyd, et al., concluded that there was a linear dose-response between the intake of radium and chromosome abnormality among the radium-dial painters.

Likewise, a linear dose-response between exposure to ionizing radiation and chromosome aberration was noted among former dockyard workers who handled radioactive substances. In an article in Nature ("Radiation-Induced Chromosome Aberrations in Nuclear-Dockyard Workers," Volume 277, February 15, 1979, pp. 531-34), H.J. Bates, et al..studied a group of workers who were exposed to neutron and gamma radiation during the refueling of nuclear reactors. His research indicates that most exposures were below the internationally accepted maximum permissible level of 5 rem per year, and that there was a significant incidence of chromosome aberration in peripheral blood lymphocytes ten years after their exposure.

In the 26-Year medical follow-up study of the Marshall Islanders who were exposed to radioactive fallout, researchers for the Brookhaven National Laboratory have discovered that at least 50% of the exposed Marshallese have manifested a rare form of chromosome aberration which is attributable to their radiation exposure. Conard et al. (1980, BNL 51261) has stated that this finding is consistent with the Japanese A-Bomb data. Of profound importance is the discovery that a higher incidence of chromosomal aberration occurs among the Marshallese group exposed to low-level radiation as opposed to the higher dose group. This same phenomenon occurs with respect to the incidence of thyroid cancer among the exposed Marshallese, whereby the lower dose group (i.e., Utirik Atoll) has a significantly higher ratio of thyroid malignancies than the higher dose group (i.e., Rongelap Atoll). This major finding among the Marshallese suggests that at higher doses of ionizing radiation the impacted cells are destroyed, whereas at lower doses the cells are merely maimed and/or maligned, and may be spared for a later malignancy or chromosomal change. This suggests that low-level ionizing radiation may be far more deleterious to human health than was previously believed, and it is this type of radiation dose the majority of the atomic veterans received during the above-ground testing period.

SUGGESTIONS TO THE COMMITTEE REGARDING A HEALTH SURVEY

Based upon the forgoing testimony, it appears that the possible adverse health effects associated with exposure to ionizing radiation--and especially at low doses--may constitute a far more serious health problem than was previously assumed. Moreover, as the scientific and medical evidence continues to filter in concerning health effects beyond cancers and leukemia, in particular cardiovascular disease and chromosomal changes with the possibility of birth defects among the offspring of exposed populations, it seems appropriate to expand the focus of radiation-induced injuries.

In this regard, the National Association of Atomic Veterans recommends the following:

- That a comprehensive epidemiological and genetic survey be conducted of the 250,000 ex-military personnel exposed to ionizing radiation during above-ground nuclear tests between 1945 and 1962
- That this survey be conducted by a truly independent and non-governmental body, such as an academic body from a major university, in order to prevent an inherent conflict of interest when government-sponsored agencies collect and assess data, and then make policy decisions based upon data interpretation
- That NAAV assist with the initial establishment of the study protocol, and that NAAV have continual input and access to data and data collection
- That the epidemiological and genetic study be both a morbidity and mortality study
- That the study will include diseases other than cancer and leukemia, such as cardiovascular disease, neuro-muscular diseases, pre-mature aging, and other degenerative diseases
- And finally, that the proposed epidemiological and genetic survey raw data and results be submitted to various independent bodies for impartial peer review so that an objective and fair analysis of the study may be achieved

In conclusion, the National Association of Atomic Veterans is perplexed about the Veterans Administration's opposition to the epidemiological and genetic study of atomic veterans and other veterans exposed to toxic substances during military service, as well as their offspring, as called for in Senator Alan Cranston's Senate Bill 11. Because no substantive data currently exists regarding the possibility of genetic and birth defects among the offspring of atomic veterans, NAAV finds it hard to believe that the Veterans Administration would go on record as opposing S. 11 which specifically calls for the first genetic study of atomic veterans and their offspring.

It is both ironic and unfortunate that the Associate Deputy Chief Medical Director of the Veterans Administration, Dr. Earl Brown, has stated at the April 6th Senate hearing that "No genetic effects exist among the offspring of atomic veterans." Not only is there no existing scientific evidence to support such a claim, but having the Veterans Administration oppose a genetic study (as outlined in S. 11) raises the most profound question about the intentions of the Agency mandated by Congress "To care for him who shall have borne the battle and for his widow, and his orphan."

Thank you.

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Letters to the Editor

CANCER FOLLOWING NUCLEAR WEAPONS TESTS

SIR,—In December, 1982, the BBC television programme *Nationwide* initiated a follow-up of men who had been involved in nuclear weapons testing in the South Pacific by inviting first-hand accounts from viewers. The programme also enlisted our help with the statistical analysis of reported illnesses and deaths.

The South Pacific tests — whose local base was Christmas Island — overlapped in time with other weapons tests. Thus, there were twelve tests in Western and South Australia between 1952 and 1957, and nine South Pacific tests between May, 1957, and November, 1958. The follow-up of the South Pacific population is far from complete but already there is evidence of an abnormally high incidence of leukaemia and other reticuloendothelial system (RES) neoplasms.

The number of British servicemen and civilians who witnessed the tests or helped with the removal of radioactive waste is not yet accurately known. However, we have provisionally estimated that 8000 of the 13 000 men who (according to an answer to a Parliamentary question on Feb 8, 1983[1]) took part in the whole series of twenty-one British tests were involved in the South Pacific tests. We are also assuming that these men had the same age distribution as all members of HM Forces serving overseas in 1957.[2] Hence, the figures for the overall size and age-distribution of the study population in table I.

TABLE I—PRESENT STATE OF THE FOLLOW-UP OF BRITISH SERVICEMEN WHO TOOK PART IN 1957–58 NUCLEAR WEAPONS TESTS

Age at Jan, 1958	Expectations for South Pacific servicemen*				Present state of follow-up		
	Age distribution†	All males	1958–82 deaths		All respondents	1958–82 deaths	
			All causes§	All cancers¶		All causes	All cancers
15–19	23·1%	1848	65	11·5	78	12	8
20–24	50·1%	4008	192	35·1	136	25	18
25–29	9·7%	776	56	13·1	25	13	10
30–34	6·0%	480	57	14·9	28	14	9
35–39	5·2%	416	81	22·0	47	20	17
40–44	3·7%	296	91	25·6	15	7	6
45–49	1·5%	120	55	15·1	1	1	1
50–54	0·7%	56	36	9·1	—	—	—
Total	100%	8000‡	633	146·4	330	92	69

*Including civilians from Atomic Weapons Research Establishments.
†See Registrar General's Statistical Review of England and Wales 1957 (HM Forces serving abroad).
‡See text.
§[illegible] of population calculated from 1961 and 1971 life-tables for England and Wales.
¶Calculated from quinary-quinquennial rates for England and Wales for period 1955–74.

If these assumptions are correct then, although the number of respondents is, thus far, only 330, the number of deaths from leukaemia and other RES neoplasms is already much higher than would be expected if all 8000 men had been followed-up (table II). For 22 of the 27 RES neoplasms in table I there is inquest, pension tribunal, or death certificate confirmation of the cause of death. 13 other servicemen, still living, have reported RES neoplasms, and these include 3 leukaemias, 7 lymphomas, and 3 cases of polycythaemia vera. For all cases of RES neoplasms the records relating to the men's whereabouts in the 1950s include dates of arrival and departure from Christmas Island, service rank and number, and camp, ship, or squadron number.

TABLE II—CERTIFIED CANCER DEATHS (1958–82): OBSERVED AND EXPECTED NUMBERS BY SITE

Site (and ICD no)	Cancer deaths 1958–82		
	Ascertained†	Expected‡	Ratio
Digestive (150–159)	21	41·0	0·51
Respiratory (160–163)	11	51·9	0·21
Other solid (170–199)	10	33·5	0·30
RES neoplasms* (200–209)	27	17·2	1·57
Total (140–209)	69	146·4	0·47

*16 leukaemias, 9 lymphomas, 1 myeloma, and 1 polycythaemia vera.
†From 330 respondents.
‡From 8000 men.

For 65 men who died from causes other than RES neoplasms there was a history of aplastic anaemia in 3 cases, polycythaemia vera in 3, and lymphoma in 2. Finally, among the men who were under 25 years of age in 1958 (and therefore still in their 40s today), there are already 10 reported cases of cataract.

For the men with RES neoplasms the documentary evidence in support of the diagnosis and weapons test involvement is such that a major artifact can be confidently excluded. This leaves as possible explanations of the high incidence of these radiation-related cancers either: *(a)* far more men at risk than the 8000 we have allowed; *(b)* much higher radiation doses than has hitherto been supposed; *(c)* much higher cancer risks from small doses of radiation than has hitherto been supposed;[1] *(d)* exposure of the men to other causes of RES neoplasms; or *(e)* a combination of some or all of these factors.

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E. G. KNOX
TOM SORAHAN
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1. Hansard (House of Commons) Feb 8, 1983. Answers to question no 117.
2. Registrar General's statistical review of England and Wales 1957. Table I. London: HMSO.

SIR,—The figures presented in the above letter by Professor Knox, Dr Sorahan, and Dr Stewart, which refer to the men involved in the South Pacific tests during 1957–58, even on the most conservative estimates reveal a subsequent incidence of RES malignancies greatly in excess of the numbers expected on the basis of the relevant population statistics when analysed strictly in accordance with life-table methods. While, as Knox and his colleagues suggest, there may be causes other than radiation for the excess RES malignancies, the reported incidence of cataract, virtually unknown as a spontaneous occurrence among young men, is a strong indication that some of those involved had received radiation greatly in excess of a safe dose.

The servicemen present at the nuclear test explosions constitute a uniquely large sample of healthy young men who were at risk of exposure to ionising radiation and among whom there now appears to be evidence of radiation related effects. To examine as fully as possible their subsequent medical histories, access to a complete nominal roll of the total group of exposed persons is required, together with full disclosure of what is known about radiation exposure of the men on duty during these tests. We urge that an independent academic body be asked to conduct a full investigation into the morbidity, mortality, and perhaps genetic effects in these men, and given the means to do so.

Sutton, Surrey — J. W. BOAG
St Mary's Hospital, London — J. FIELDING
London — JOHN H. HUMPHREY
Welsh National School of Medicine, Cardiff — ALLAN JACOBS
St Bartholomew's Hospital Medical College, London — PATRICIA LINDOP
London — JOSEPH ROTBLAT
Middlesex Hospital Medical School, London — JAMES A. THOMPSON

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‘Lancet’ letter backs A-test cancer theory

by PAUL LASHMAR

CLAIMS that British servicemen have died and suffered illnesses from being present at British nuclear tests in the 1950s and 1960s have been supported by evidence from a leading cancer expert.

Dr Alice Stewart, of the University of Birmingham, has established that 27 men from a sample of 330 veterans of atomic tests on Christmas Island in the late 1950s have died of cance of the blood-forming organs. This kind of cancer, which includes leukaemia, has a high incident rate among people exposed to substantial doses of radiation.

In a letter to the medical journal, the *Lancet*, published yesterday, Dr Stewart said that statistically she would have expected only 17 deaths from these cancers in the entire batch of 8,000 men who served on Christmas Island.

A group of British nuclear test veterans has formed an association to fight for compensation for men and the relatives of men who they say suffered as a result of being at the tests.

So far, the Ministry of Defence has maintained that no one suffered from the tests and has refused to pay pensions to men who claim they have suffered illnesses from being exposed to radiation. The ministry says that safety rules at the tests were ‘stringently observed.’

In January, three days after a front-page article in THE OBSERVER highlighting the plight of the veterans, the Ministry of Defence announced it would organise a mortality survey of the 12,000 servicemen who had been at the tests at Monte Bello and Christmas Island and the Maralinga test range in Australia.

Dr Stewart's figures have been compiled from names given to [illegible] from letters from former servicemen written to BBC Nationwide and THE OBSERVER.

A second letter in yesterday's Lancet from a group of seven eminent doctors and professors, all experts on radiation and its effects, supports Dr Stewart's data and calls for a full independent inquiry.

One of the group, Dr Jack Fielding, Honorary Consultant Haematologist at St Mary's Hospital, Paddington, described Dr Stewart's figures as ‘amazing and unexpected.’

He said yesterday: ‘It is clear that the sample of 330 are self-selecting but Dr Stewart has already found a much greater incident of cancer of the blood-forming organs than you would expect from the entire sample of 8,000 men.’

Dr Fielding is certain that many of the men have been exposed to radiation. ‘What is also striking is the amount of additional evidence from the data that many of the men have been exposed to radiation. If you include those who died of other causes but had cancers like leukaemia and suffering from these cancers like leukaemia and include men still alive but suffering from these cancers you get 45 cases—15 per cent of the sample.

‘Ten of the sample have cataracts, whch in men of these ages are rare except for those exposed to radiation.’

The seven doctors and professors want the ministry's survey to be turned over to an independent body and extended to cover servicemen who are living and to test the sons and daughters of veterans.

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—News and Comment—

New A-Bomb Studies Alter Radiation Estimates

The basis of 15 years of radiation research may be in error; radiation toxicity may be understated

Some of the most important data on the effects of nuclear radiation on humans may be wrong, according to new research being done at the Lawrence Livermore weapons laboratory in California and the Oak Ridge National Laboratory in Tennessee. The new findings are far from welcome, as one consultant in this work says, for all the revisions "are moving in the wrong direction"—a direction that will worry the advocates of nuclear power. Government physicists have recalculated the data on the radiation fields created by the atomic blasts at Hiroshima and Nagasaki and produced some unexpected results. Their statistics show that most of the cancer caused by those bombs came from low LET gamma rays,* suggesting that this common type of radiation is more hazardous than had been assumed before.

The impetus for the revision comes primarily from Livermore, where physicists William Loewe and Edgar Mendelsohn last year used a computer to reconstruct the two explosions. Their findings are being checked and complemented by a group at Oak Ridge led by George Kerr. He began work on a similar project in 1977, shelved it, and then returned to the task in earnest when Loewe's data became known. Dean Kaul of Science Applications, Inc., in Chicago also carried out some early calculations that sparked interest in the issue. Kerr, Kaul, and Jess Marcum of Research and Development Associates in Santa Monica, California, have been funded by the Defense Nuclear Agency to explore the problem and check some of the old assumptions which have not yet been reexamined.

Although they differ in some of the details they stress, all of these scientists agree that the accepted figures for high LET (neutron) radiation at Hiroshima are grossly overstated. For example, the neutron radiation at a distance of 1100 meters from the epicenter of the blast appears to have been overestimated by a factor of 6 to 10. Since the effects on human health remain the same, one must conclude that the gamma rays were more toxic than had been thought.

U.S. Air Force

Did it produce neutrons or mostly gamma rays?

Duplicate of the bomb that hit Hiroshima

If this research proves correct—and it has survived a few peer challenges already—it will necessitate the rewriting of many basic documents on the hazards of radiation, including the chief attempt to define such risks published in 1980 by the National Academy of Sciences. That study, the work of the Committee on the Biological Effects of Ionizing Radiation (the BEIR report), was fraught with controversy on this very question.

Although much of the BEIR report was released to the press in May 1979, the Academy decided to recall and rewrite it because of dissension among the authors. Some of them, led by Columbia University biophysicist Harald Rossi, argued that the paper overstated the cancer-causing effects of low LET radiation. Their arguments leaned heavily on Japanese data and particularly on the thesis that many of the cancers in Hiroshima were produced by high LET neutron radiation.

Using the old Hiroshima radiation data as evidence, Rossi argued that the BEIR committee should lower the cancer risk estimates published in an earlier BEIR report in 1972. Instead, the committee raised the risk estimates. Rossi considered this an alarmist move and withdrew his support from the document. In the end, the Academy felt compelled to write a report that effectively split the difference between Rossi's point of view and that of his chief adversary, the committee chairman, Edward Radford, an epidemiologist at the University of Pittsburgh. The risk estimates in the final report of July 1980 were not as high as Radford argued they should be nor even as high as those in the 1972 report. Neither Radford nor Rossi endorsed the document.

Rossi concedes that the Livermore calculations may do away with the evidence for his theory that neutrons were responsible for the high cancer incidence in Hiroshima. But he does not expect to alter his general view that the hazards of radiation are exaggerated. Radford, in contrast, says the new Hiroshima data vindicate his position and invalidate Rossi's. Furthermore, Radford considers the BEIR 1980 report obsolete and expects that the probabilities it gives for the risk of dying of cancer after exposure to gamma radiation will be doubled. Likewise, he thinks the probabilities for contracting any form of cancer after irradiation will be quadrupled.

The importance of the new research is that it completely changes the scheme of radiation doses that people are supposed to have received in Japan, particularly in Hiroshima. Until now, it was thought that the Hiroshima blast was unique in that it produced a large field of fast neutrons, a high LET form of radiation. Neutron radiation is considered more dangerous than low LET radiation, a category that includes x-rays, electrons, and gamma rays. Its singular presence in Hiroshima was said to make the cancer risk found there anomalous. Most of the radiation people encounter is not of this kind. The wastes from nuclear reactors, for example, emit gamma rays. Thus, a

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*The terms "low LET" and "high LET" (for linear energy transfer) refer to the physical quality of the ray. Low LET radiation loses relatively little energy as it travels along its course, and includes electrons, gamma rays, and x-rays. High LET radiation loses energy more rapidly as it travels, and includes beams of neutrons and protons.

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number of scientists have always considered Hiroshima a special, high-risk case, and in studying the peacetime hazards of radiation, they have discounted some of the cancer data from that city.

As it happens, the cancer mortality data from Hiroshima are the most valuable in the world. Unlike the data from Nagasaki, they are abundant enough to reveal a clear relationship between doses of radiation received and ill effects. That relationship is defined by a linear equation: an increase in dose above the natural background radiation correlates with a proportional increase in ill effects. The pattern suggests that any increase in radiation, no matter how small, directly increases the risk of getting cancer. The mortality data from Nagasaki are sketchier, making them susceptible to a variety of interpretations. The significant point is that if the new bomb calculations are accurate, the data from Nagasaki and Hiroshima can be combined and treated as a single, coherent pattern of response to low LET radiation. It is too early to say precisely what that pattern will look like, because now the doses must be recalculated for each radiation victim. But most of the researchers who spoke to *Science* said the new data would probably increase the risk estimates for gamma radiation.

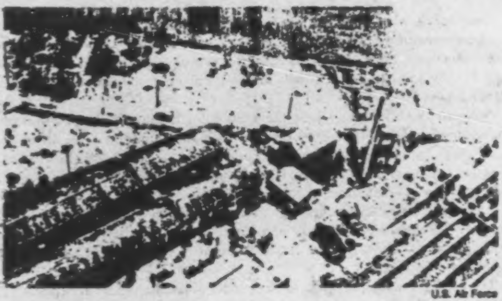
Radford, an advocate of this point of view, claims that the argument over Hiroshima and its mortality data has been a distraction from the main body of scientific evidence. He says the 1980 BEIR report miscalculated in emphasizing mortality data so heavily, for death certificates do not give a very accurate reading of the number of cancers or even cancer deaths in a community. Radford thinks it was a mistake to pay so much attention to Rossi's theory about deaths in Hiroshima, for he claims the theory is contradicted by "90 percent" of the epidemiological data on record. He is pleased that the Hiroshima data may now look consistent with all the rest.

"The implications are far reaching for health regulation and nuclear power in this country in general," says David Auton, a physicist in the office of target and damage assessment of the Defense Nuclear Agency. His office is funding the research at Oak Ridge that may confirm the new dose estimates. As he describes the situation, the health physics community faces a nasty dilemma, if the new bomb data are accurate. On one hand, the standard-setters may adhere to Rossi's principle, which maintains that many of the cancers produced in Hiroshima were caused by fast neutrons. But the number of neutrons thought to have been present is now so small that one must account for their effects by increasing the estimate of their potency. The resultant killing power of neutrons is "incredible," Auton says. Industrial safety rules would have to be revised, reducing exposure limits for neutron radiation to one-tenth of the present limits. For critical jobs, companies would have to employ ten times as many people.

On the other hand, the health physics community may abandon the Rossi principle and conclude that nearly all the cancers in Hiroshima were produced by gamma rays, not neutrons. That news will not be welcome either.

Auton wishes frankly that someone else were funding this research, which he thinks is important for future health and energy policy. His office is doing it because "nobody else was interested." The controversy has been brewing for at least 4 years, for that is how long it has been since a government consultant first raised serious questions about the validity of the Hiroshima data. According to Auton, however, it was just 5 months ago that he was approached by Harold Wyckoff, chairman of a special committee assigned to study this question for the National Council on Radiation Protection and Measurements. It is a private organization that collects and publishes radiation risk information. Since no other agency would fund the research, Auton says, he agreed to have the Defense Department pick up the tab for work being done at Oak Ridge, and thus come up with some answers for Wyckoff. The funding began about a month ago.

"This work is of marginal interest to us and we really can't afford to spend very much money studying civil effects," Auton says, but it is important to resolve the uncertainties. It might make more sense for the Department of Energy or the Nuclear Regulatory Commission to pay for this work, and "the electric power people really should be interested," according to Auton. It is important that the new research be credible. Auton agrees that it would be best if the sponsor were an independent group not associated with the weapons program or the nuclear industry.


U.S. Air Force

Hiroshima, 1945

Some concrete buildings survived the blast.

Arthur Upton, the former director of the National Cancer Institute and an expert in radiobiology, has followed this controversy closely since he learned of the new bomb data last fall. It is an important issue, he says, and should be the subject of more research, sponsored by a neutral scientific organization such as the joint U.S.–Japanese Radiation Effects Research Foundation. If the new dose estimates are correct, Upton says, "I am not sure one can substantiate the Rossi thesis." It may remain important for radiobiology, for there are differences in the way that plants and animals respond in the laboratory to high and low LET radiation. Upton agrees with Radford that the new data greatly strengthen the argument that there is no "safe" level of exposure to radiation, in that every incremental bit of exposure increases the chances of injury.

One of the curious aspects of this research is the manner in which it was published. The record serves as a compelling argument for declassifying as much as possible of what is done at government labs, for many of the assumptions in this case might have been challenged sooner had the underlying data been available for scrutiny.

The Rosetta stone of Japanese radiation dosimetry is known as T65D, which stands for tentative dose estimates compiled in 1965. The figures were assembled by physicist John Auxier of Oak

Ridge in a painstaking analysis of measurements made during and after the Japanese blasts, interviews with the bombardiers, and a test explosion in the Nevada desert. Some of his work was classified because it described in detail the makeup and radioactive output of the Little Boy (Hiroshima) and Fat Man (Nagasaki) bombs. Auxier's methods of computing the doses, which underlie 15 years of research on health effects in Japan, were never described in detail. In 1977, however, the government published a quasi-technical narrative by Auxier (*Ichiban*, Energy Research and Development Administration, TID 27080) giving some additional information on Auxier's methods.

As questions about these figures arose in the late 1970's, the National Council on Radiation Protection (NCRP) asked Auxier to justify his estimates with more supporting information. After working on this project for several months, Auxier explained that he could not reproduce all the data because some had been lost. He explained to *Science* that when Oak Ridge was reorganized in 1972, he was moved from one place to another, and his old classified files were left behind in his laboratory. Auxier says that the records division at Oak Ridge made a mistake in shipping the files: the valuable data were sent to the shredder.

The NCRP continued to ask for confirmation of the T65D numbers because they had become important in the debate on the hazards of radiation and because new data were becoming available. In 1976, the Los Alamos Scientific Laboratory in New Mexico, a weapons design center, released an estimate of the radioactive output of the Hiroshima bomb for the first time. The figures were not published, but given in a private letter to C. P. Knowles of Research and Development Associates, who was trying to help the Defense Nuclear Agency pin down the precise explosive power of the Fat Man bomb. This is one of the key uncertainties in the record: some say the blast equaled the power of 12.5 kilotons of TNT, and others say it may have been as potent as 15 kilotons. Several people in the weapons and biophysics community soon obtained copies of the letter, including Kerr at Oak Ridge and Kaul at Science Applications. Using the new data and computer techniques not available when Auxier did his research, Kaul and Kerr in separate projects came up with numbers that were at odds with the T65D results.

Kerr's laboratory is the best equipped and best funded for this expensive computer work, Kaul says, and for that reason it has been given the primary responsibility for reviewing the old numbers. Kerr's task is complicated by the fact that he is in a sense Auxier's successor at Oak Ridge and works just down the hall from this senior official whose work he has been asked to review.

Auxier, meanwhile, says that his data are the best available, not likely to be changed much by the work of latter-day

Technology Transfer Reappraised

Transfer of technology from industrialized countries to developing countries emerged in the 1970's as a highly charged issue in the so-called North-South dialogue. Less-developed countries protested that control of technology by the industrialized North keeps them in a state of technological dependence.

A report* just issued by the Organization for Economic Cooperation and Development (OECD) in Paris questions major assumptions on which the technology transfer debate has been conducted. It argues that technology transfer has been mutually beneficial for industrialized and for developing countries, or at least some of them.

The report notes that technology transfer has helped a group of "industrializing" developing countries to participate, on stronger terms, in the world trading system. These include Brazil, Mexico, South Korea, Taiwan, Hong Kong, and Singapore.

The report's main challenge to the notion of technological dependence is its assertion that "technological monopolies are temporary," that change is propelled by a "technology cycle." New technology introduced in one country is transferred under tight control first to other developed countries and then to less-developed countries. As licensing and sale of the technology spreads, it becomes standardized.

Proof that this process is working is seen in the rise in imports by industrial countries of manufactured goods from developing countries. Moreover, some industrializing countries are themselves exporting technology, mostly in the form of turnkey plants and equipment.

Feedback from technology transfer also affects industrial countries. The impact has been most conspicuous in the decline of traditional industries, notably clothing, footwear, and light manufacturing, that have faced offshore competition. Loss of jobs has created a protectionist backlash that includes criticism of technology transfer. But, says the report, technology transfer has benefited the United States and other OECD countries by creating export markets for their capital-goods industries during a period of slow growth.

By focusing on the industrializing countries, the report offers a selective view of the problems facing developing countries. It does note in passing that for the poorest countries, the cost of imported oil, trade deficits, and foreign debt make the outlook bleak. Even for the industrializing countries, the burden of energy costs, deficits, and debt have "led to pessimism regarding future financing of development."

The report was prepared by the staff of OECD, which is essentially a club of governments of western industrial nations plus Japan. OECD serves as a data gathering and intergovernmental policy-planning organization. It is, therefore, not surprising that the report assesses technology transfer mainly from the sellers' point of view.

In broad terms, what the report's authors say is occurring is a major restructuring of the international industrial system. For the industrial countries an "adaptive strategy" is counseled. With a two-way trade in industrial products now established, the North can retain its comparative advantage only by keeping its "innovatory capacity" at a high level. Pressure to transfer R & D activities to developing countries will build as their scientific infrastructures strengthen. The report borrows from Lewis Carroll to observe that industrial countries must "keep running to stay in the same place."—JOHN WALSH revisionists. His judgment is widely respected. As the grand old man in this field, he is in a position to influence funding decisions on new research. Auxier told *Science* there is no need for an independent review of the discrepancies between his data and Kerr's, expressing an opinion which may have made it difficult to get the present review started. Auton, the Defense Nuclear Agency official who makes the funding decisions, says that he has great respect for Auxier's work, a respect based as much on Auxier's standing in the community as on his ability to "drag out corroborative data."

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*North-South Technology Transfers: The Adjustments Ahead. Organization for Economic Cooperation and Development, Paris, 1981. $12.

Kerr has never published any of his work outside the laboratory, he says, because he prefers to be "timid" about it. Earlier controversies have taught him to move cautiously in matters as important as this, and he still thinks there could be some weaknesses in the new bomb data.

This stalemate existed for several years until the summer of 1980 when Loewe decided to rework the calculations. He started the project because the old Hiroshima data and Rossi's recent warnings about the potency of neutrons worried people in the lab. Livermore scientists are involved in weapons research and are frequently exposed to neutron radiation. They wanted to know more about the dangers. Loewe's investigation, completed last October, found both the Hiroshima data and Rossi's principle to be unsubstantiated. Loewe argues that there is no evidence showing that neutrons were present in significant quantities in Hiroshima.

Loewe, Kerr, Auxier, and others in this controversy will present their arguments at a meeting sponsored by the Radiation Research Society on 31 May in Minneapolis. Auton calls it "the beginning of an important dialogue," one which he probably will not be able to attend because the new Administration has reduced the bureaucracy's travel allowances. But Auton hopes the meeting will lead to a general and independent review of the issues. "If the weapons folks" make it a strictly internal project, he says, "I just have a concern that nobody will believe the results."

—Eliot Marshall

Science Adviser Post Has Nominee in View

The job, turned down by several candidates, may now be offered to a man who is not a member of the science establishment

The choice of science adviser to President Reagan has been narrowed down to a single candidate: George A. (Jay) Keyworth, a 41-year-old physicist from the Los Alamos Scientific Laboratory. Although the job had not formally been offered to Keyworth as of this writing, Administration officials expect an announcement by the end of May, but caution that something could still go awry even at this late stage of the selection process.

When Keyworth's name came up as a potential candidate late in April, it drew a mixture of surprise and unease from the scientific establishment. The surprise stems from the fact that Keyworth is virtually unknown outside his field. And the unease is related to the fact that his candidacy was being vigorously supported by Edward Teller, the so-called "father of the hydrogen bomb," and Harold Agnew, president of General Atomics and former director of Los Alamos. Both are well known for their hawkish defense views.

Those who know Keyworth describe him as smart and personable. His research has been concerned mostly with nuclear structure and low-energy nuclear reactions, and for the past 3 years he has directed the physics division at Los Alamos. One scientific colleague, Arthur Kerman of MIT, describes Keyworth as "a very good scientist who is a lot broader than his background would indicate."

Outsider causes unease

Candidate George Keyworth

His background does not, however, include service on the usual round of government science committees. Hence he has little experience with federal science policy and has made few links to the scientific establishment. "He doesn't provide any channel between the national (scientific) community and the White House," complains one veteran of science and government affairs.

Such concerns are abruptly dismissed by Keyworth's supporters. Although he "lacks obvious credentials, that doesn't mean he will not do a superb job," says one. Agnew scoffs that "he has all the right credentials—all he doesn't have is 20 years membership in the club." In a telephone interview with *Science*, Agnew also said that he thinks much of the unease about Keyworth is simply due to the fact that he is an outsider—"If you get a bunch of chickens together and you put in a new rooster, they start clucking and running around," he remarks.

As for Keyworth's shortage of links to the scientific establishment, Agnew says that "defense will be the thrust of this Administration, and somebody who has the respect of the people in the defense labs is needed." He adds: "For the past four years, you have had a geologist in charge, and the defense community has suffered."

How did somebody from outside the traditional ranks of candidates for science adviser get selected? Keyworth says he was approached about the job early in April, and "it came as a surprise to me." The post was formally offered in March to Arthur Bueche, head of research and development at General Electric, but he was forced to turn it down for personal reasons. Several other people were subsequently sounded out about

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WRITTEN TESTIMONY OF DRS. SIDNEY COBB AND DONNELL W. BOARDMAN, SUBMITTED TO THE VETERANS AFFAIRS COMMITTEE OF THE HOUSE OF REPRESENTATIVES, MAY 24, 1983

Sidney Cobb MD holds a masters degree in public health and is board certified in preventive medicine and public health. He is now professor emeritus of community health in Brown University. Before coming to Brown, he taught epidemiology and did epidemiologic research at several schools of public health, including Harvard, Johns Hopkins, University of Pittsburgh, and University of Michigan. Donnell W. Boardman MD is practicing internal medicine in a group practice HMO setting which he helped to found. Together with others we (Drs. Cobb and Boardman) formed The Center for Atomic Radiation Studies, Inc. (CARS). A brochure describing CARS is appended to this testimony. For the moment it is sufficient to say that this non-profit corporation was established to try to ascertain and disseminate the truth about the radiation exposure of atomic veterans and the health changes that these veterans have experienced as a consequence of their exposure.

In the affairs of atomic veterans there appear a great many assertions and opinions when actually there is a paucity of well established facts. In addition there have been regrettable problems of secrecy and distortion. There are three areas in which the facts need to be ascertained and made public: degree of radiation exposure, extent of illness in those exposed, and the relationship of dose to delayed illness in humans.

First, the amount of radiation received by individual atomic veterans needs serious and detailed investigation. Radiation dosage should be presented in rads or rems per man year; yet the Defense Nuclear Agency obfuscates the matter by presenting the dose per badge (many people wore more than one badge) without indicating that the badge gives no measure of alpha and beta radiation (DNA Fact Sheet, Nuclear Test Personal Review, 10 Jan., 1983). It is evident that those veterans who were exposed to fallout have had their exposure underestimated by the DNA.

Second, there has been only one epidemiologically adequate study of U.S. atomic veterans reported (Caldwell GG et al, JAMA 244: 1575, 1980). Dr. Caldwell is still working on the mortality of the approximately 3,000 men present at shot Smoky of the Plumbob series. In other words, 20 odd years after the last atmospheric test we have only a partially completed study of about 1% of the 250,000 men alleged to have been exposed. In fact, it would appear from the Defense Nuclear Agency Fact Sheet mentioned above that even the 28 men who were grossly exposed on Rongerik Island by the change of wind at Castle Bravo have not been fully followed up.

Third, we may never have all the facts we might like on the relationship between radiation dose and human disease because investigation of effects at low doses requires the study of very large populations in order to get competent measurement of the frequency of health effects. At the present time our need for more information is so great that we cannot afford to let any atomic veteran go unstudied.

On the other side of the coin what do we know?

1. U.S. military personnel were involuntarily used as research subjects at atomic blasts.
2. The studies in question have not been completed, for there is still much information to be gained from long term follow-up of these men who risked injury, disease, and death. Though the original experiment cannot be considered morally defensible, it would be a further immorality to fail to maximize the information gained from the experiment, since no further injury will be caused by completing the study. Those who argue otherwise must defend themselves against a charge of being afraid of the truth that is likely to be revealed.
3. Radiation can cause cancer, particularly of the reticulo-endothelial system such as leukemia, lymphoma, and polycythemia vera. In addition a variety of other diseases may be caused by radiation. Permanent chromosome damage is proportional to dose. Sterility, fetal wastage, and congenital defects may be caused (Levy BS and Wegman DH Occupational Health, Chap 13).
4. Atomic veterans who were present at Plumbob Smoky have suffered with an excess of leukemia and polycythemia vera. Those with the heaviest exposures probably have suffered with a variety of other diseases, but that has not been revealed to us as yet. (JAMA 244: 1575, 1980) Preliminary results from England suggest similar findings for British atomic veterans (Lancet April 9, 1983 p. 815).

5. The Defense Nuclear Agency appears to take the position that the average exposure was too trivial to have produced excess disease.
6. The atomic veterans claim that they suffer excessively with radiation induced disease.

Neither of the last two conflicting views is adequately supported. It is imperative, not just for the atomic veterans but for all of us who must live in this atomic age, to know the truth. This requires careful large scale, long term epidemiologic studies. These studies should be carried out by universities or other independent research agencies that have high credibility. To have these studies done by the Veterans Administration, as proposed by Senator Cranston in s-11, is not appropriate, because unfortunately The Veterans Administration, the Defense Nuclear Agency, and some related government agencies have lost their credibility in this matter by their disingenuous behavior.

It is our belief that this research will be productive only if it is done outside the government, on a grant rather than a contract basis, and if the grants are awarded within the existing peer review system of The National Institutes of Health and The National Science Foundation. Furthermore, classified information must not be denied to key research workers. If it is truly not in the best interest of the country to declassify the relevant information, then security clearance must be provided for appropriate research personel. Finally, literal interpretation of the Privacy Act must not be allowed to interfere with giving names, addresses, and other personal data to medical personnel who are trained to protect the confidentiality of patient information.

If such a research program is to be carried out it is likely that its value to humanity will far exceed its cost.

Sidney Cobb MD
Donnell W. Boardman MD

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During the period 1945–1963 more than a quarter million U.S. military personnel were exposed to radiation at 235 announced nuclear weapons tests. The Center for Atomic Radiation Studies (CARS), Inc. grew out of an obvious need for coordination of effort, sharing of information and the pursuit of new research on the problems of these atomic veterans. It was founded July 31, 1982 by a small group of concerned persons. Its purposes are two:

1. Promote and coordinate research on the biomedical aspects of exposure to atomic explosions, and to collate, summarize and distribute such facts in this area as may from time to time become available;
2. Promote and coordinate research on social, psychological, political, historical and legal matters that have a bearing on the quality of life of persons exposed to atomic explosions and to collate, summarize and distribute relevant information to appropriate people.

The corporation is non-profit (applying for 501(c)(3)) and has three classes of membership:

1. **Organizations** concerned with the plight of persons exposed to atomic explosions;
2. **Professional persons** who have done or are now doing research on matters relevant to those who have been exposed to atomic explosions;
3. **Individuals** who want to support the organization with information, work or money.

CARS is governed by a board of directors which includes some liaison persons from member organizations and some representatives from among the professional and individual members. A professional advisory committee will develop the scientific program of the organization and will offer its resources to those engaged in research projects that may be operated by, funded by or merely encouraged by the organization.

Dues to the organization are currently set at $100 per annum for organizations and $25 per annum for individual members of the corporation.

The current officers are:

President — Sidney Cobb, M.D., M.P.H.
Clerk — Donnell W. Boardman, M.D.
Treasurer — Deborah Klein Walker, EdD.

A brief curriculum vitae for each officer and board member can be found below.

It is our present intention to initiate the following projects as rapidly as people and funds become available:

1. Historical documentation of the some 235 atomic explosions to which American military personnel have been exposed. The documentation will include as minimum information: time, place, type of weapon and numbers of military personnel exposed by type and distance of exposure. (Where possible, exposed populations will be defined precisely);
2. Development and maintenance of a library of materials relevant to the purposes of the organization;
3. Development and maintenance of a name and address file of American military personnel known to have been exposed to one or more nuclear explosions;
4. Clinical evaluation of atomic veterans;
5. Documentation of all relevant legal cases, be they closed or pending;
6. Follow-up of a selected few identified populations whose exposure can be documented to determine if the individuals have suffered any health and/or procreative effects.

These functions will require administrative support, public information membership and fund-raising activities. CARS was conceived as and is designed to remain primarily a volunteer and autonomous organization, but as the Center grows, paid staff will be engaged to assume administrative and operational functions.

Biographic Sketches of Board Members

Dr. Sidney Cobb is Professor Emeritus of Community Health and Psychiatry at Brown University. He has assumed the leadership of CARS, Inc. with a background of 35 years research and teaching in the field of epidemiology of non-infectious diseases first at the University of Pittsburgh, then the University of Michigan and more recently at Brown University. His B.S., M.D. and M.P.H. degrees were all awarded by Harvard University. He received his clinical training at the Johns Hopkins Hospital and he is certified by the American Board of Preventive Medicine and Public Health. He is a member of many national and international organizations including the American Epidemiological Association, The Society for Epidemiologic Research and the International Epidemiologic Society. He is a past president of the American Psychosomatic Society and is a member of the editorial board of Psychosomatic Medicine. He lives at 4 Water Street, South Easton, MA 02375. Tel. (617) 238-3345.

Dr. Donnell W. Boardman is a practicing internist at the Acton Medical Associates (founder and emeritus) and Emerson Hospital, Concord. After taking a B.A. at Yale and M.D. at Columbia and hospital training at Roosevelt and Bellevue in New York City, he served during WWII with the U.S. Civil Service Commission in clinical and administrative medicine. He has held teaching affiliations at Boston University School of Medicine and appointments in medicine and allergy at Massachusetts General Hospital. He participated in the founding of the Multi-Group Health Plan. He developed one of the early ICU-CCU facilities and introduced medical student and graduate continuing education at Emerson Hospital. He started the Roxbury Dental and Medical Group in Boston and was an original founding member of Physicians for Social Responsibility of '62–'63. Publications have dealt with medicine in the nuclear dilemma, the social scene, medical education and religious conviction in action. His address is P.O. Box 146, Acton, MA 01720. Tel. (617) 263-5562.

Dr. Deborah Klein Walker is Assistant Professor of Human Development in the Department of Behavioral Sciences and in the Department of Maternal and Child Health, Harvard School of Public Health, and Assistant Professor of Education in the Laboratory of Human Development, Graduate School of Education. She is a co-principal investigator of the Harvard Community Child Health Studies. Her research interest and expertise include assessment in behavioral and social aspects of family living with special emphasis on studies of children and adolescents in natural setting. Her B.A. was awarded with High Honor by Mt. Holyoke, and she received her doctorate in education from Harvard University. She is the author of one book and more than a dozen papers in scientific journals. She is a member of the American Psychological Association, American Public Health Association and the American Education Research Association. She lives with her husband and children at 68 Holworthy Street, Cambridge, MA 02138. Tel. (617) 661-1728.

Daniel Burnstein is an attorney with an office on Beacon Hill in Boston. He has a broad civil practice which includes concentrations in medico-legal issues and Freedom of Information litigation. Mr. Burnstein also represents numerous foundations with tax exempt/tax deductible status. He has taught various subjects at college and law school levels including U. Mass. Boston, Boston College and Harvard Law School. His office is at 33 Mount Vernon Street, Boston, MA 02108. Tel. (617) 227-8840.

Sandra Marlow is a professional librarian at Southeastern Correctional Center where she has established a law library and updated the general library. She holds a B.A. from Adelphi University, M.A. in Art, University of California at Davis, and M.L.S. from the University of Rhode Island. She is the academic and scientific chairperson and archivist of the National Association of Atomic Veterans (NAAV) and has been collating atomic veterans' case histories since 1977. She has represented NAAV as a speaker at frequent government hearings and public meetings. An article by her is to be published in the January 1983 Bulletin of Atomic Scientists. She lives at 65 Acushnett Road, Mattapoisett, MA 02739. Tel. (617) 758-2751.

VETERANS OF FOREIGN WARS OF THE UNITED STATES

OFFICE OF THE DIRECTOR

STATEMENT OF

JAMES N. MAGILL, SPECIAL ASSISTANT
NATIONAL LEGISLATIVE SERVICE
VETERANS OF FOREIGN WARS OF THE UNITED STATES

BEFORE THE

SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS
COMMITTEE ON VETERANS AFFAIRS
UNITED STATES HOUSE OF REPRESENTATIVES

WITH RESPECT TO

RADIATION EXPOSURE

WASHINGTON, D.C. MAY 24, 1983

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

Thank you for the opportunity to present the views of the Veterans of Foreign Wars of the United States with respect to certain illnesses and disabilities now being incurred by veterans who were exposed to ionizing radiation while serving on active duty with our Armed Forces. We are appreciative of this Subcommittee for holding this hearing and demonstrating its continuing concern for our nation's veterans.

As you know Mr. Chairman, beginning in 1945 and continuing until 1963 the United States Government conducted approximately 235 atmospheric nuclear tests over the American Southwest and Pacific Ocean. Participating in these tests were more than 250,000 servicemen and women; with many positioned alarmingly close to the blast. Records indicate some participants were positioned in trenches about 2,000 yards from ground zero, and, in one instance, six volunteers stood at ground zero while a nuclear device was detonated 20,000 feet overhead. Others, while not in close proximity to the actual blast, were transported or marched to

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ground zero soon after the detonation and put through simulated combat maneuvers to test their reactions to such a destructive force. Even then, concern was being voiced as to the possible dangers involved with nuclear testing. According to government documents, in the early 1950's the Atomic Energy Commission cautioned that troops involved in nuclear weapons tests might be exposed to harmful levels of radiation. The Department of Defense responded to this warning by assuming responsibility for the safety of those Armed Forces personnel who participated. However, specific health risk information was withheld from participants before and after their exposure to ionizing radiation. We find it particularly disturbing that the Armed Forces elected to withhold this information, supplied by an authoritative Commission, and proceed with tests not knowing what after-effects could be expected. Because of this, the VFW believes the federal government has a moral obligation to conduct systematic follow-up studies to identify veterans exposed to ionizing radiation during nuclear weapons testing and expedite medical treatment for these veterans at the highest priority level.

Mr. Chairman, we believe there is more than just a casual relationship between certain diseases and exposure to ionizing radiation. Information available to us indicates a significantly higher percentage of veterans who were participants at nuclear tests are suffering certain cancers than is evidenced in a normal population sample. For example, the 3,224 participants of a 1957 nuclear test are now showing an incidence rate for leukemia nearly three times the norm and a ten-fold incidence above the norm for polycythemia vera, a rare bone marrow disease. There is also a higher than usual incidence rate for tumors, sterility, pre-mature aging, and general tissue and organ degeneration. Inasmuch as these veterans led varied life styles prior to their military service and then continued diversified styles after their military obligation, we believe the only common denominator with respect to certain illnesses is their exposure to ionizing radiation.

Mr. Chairman, while Public Law 97-72 provides medical care at Veterans Administration medical facilities for those who can establish they were participants in nuclear testing, we believe this care should be provided on a higher priority level. More important, PL 97-72 does not ensure health care on a uniform or consistent basis throughout the VA medical care system. Care is provided at the determination of a responsible VA staff physician without the benefit of established guidelines. Circular 10-83-61, while expanding the scope of treatment, still does not establish uniformity or consistency within the system and is only effective for one year.

Mr. Chairman, as stated previously, the VFW believes veterans exposed to excessive levels of radiation should be qualified for VA health care at the highest priority level. Therefore, we suggest that such veterans be provided presumptive service-connection similiar to that of those eligible under Section 602 of Title 38. We also recommend (1) an advisory committee be established to study matters related to health problems arising from radiation exposure; (2) workable and realistic guidelines be developed and implemented for the adjudication of ionizing radiation claims and; (3) that a statistical study be undertaken to establish if or what relationship does exist between radiation exposure and certain illnesses.

Finally Mr. Chairman, we support the passage of legislation such as H.J. Res. 210, introduced by the Chairman of the Subcommittee on Hospitals and Health Care, the Honorable Robert Edgar, establishing July 16, 1983 as "National Atomic Veterans Day". By setting aside one day, the sacrifices of this special group would be recognized and much needed emphasis placed on the importance of resolving a serious problem.

Mr. Chairman, in reaffirming our continuing concern that there is indeed a relationship between certain diseases and radiation exposure, the voting delegates to our most recent National Convention adopted Resolution No. 621 entitled "Radiation Exposure - Dosage Values and Service Connection", a copy of which is appended to my statement for your review.

This concludes my statement. I will be happy to answer any questions you may have.

Resolution No. 621

RADIATION EXPOSURE-DOSAGE VALUES AND SERVICE CONNECTION

WHEREAS, hundreds of nuclear tests have been conducted since the advent of the Atomic Bomb exposing thousands of service personnel to ionizing radiation; and

WHEREAS, medical science has determined that certain diseases are related to exposure to ionizing radiation and others may be added as research continues; and

WHEREAS, dosimetric devices used to measure the amount of such radiation have been found to contain readings varying in accuracy from 20 to 50 percent; now, therefore

BE IT RESOLVED, by the 83rd National Convention of the Veterans of Foreign Wars of the United States, that we urge Congress to recognize this real problem by instituting legislative measures that will authorize service connection for conditions medically recognized, regardless of recorded readings, as being reasonably attributable to radiation exposure, if the disease occurs after such radiation exposure, regardless of date of onset or diagnosis.

Adopted by the 83rd National Convention of the Veterans of Foreign Wars of the United States held in Los Angeles, California, August 13-19, 1982.

Resolution No. 621

TESTIMONY OF Lt. Col. DAVID J. PASSAMANECK, USA, Ret.
NATIONAL LEGISLATIVE DIRECTOR, AMVETS

Before The
SUBCOMMITTEE ON OVERSIGHT & INVESTIGATIONS

Of The
COMMITTEE ON VETERANS AFFAIRS
U. S. HOUSE OF REPRESENTATIVES

24 May 1983

WITH REGARD TO RADIATION EXPOSURE

The American Veterans of World War II, Korea and Vietnam (AMVETS) appreciates this opportunity to present its views on the extremely important issue of adequate medical and compensatory care for veterans who have been exposed to radiation.

AMVETS is concerned with two aspects of the problem of the residuals of exposure to atomic radiation. The first concerns the statutory time delimitation for finding service connection for compensatory and treatment purposes. Under current law, certain disabling conditions are presumed to be service connected even though they become manifest after separation from service. The longest presumptive period for service connection, an indefinite presumptive period is 7 years for multiple sclerosis. For the purpose of eligibility for medical care, certain conditions, under certain circumstances will entitle the affected veteran to treatment in a VA facility. Of particular relevancy is Section 610(e)(1)(A) and (B) of Title 38, United States Code which provide such medical care for Vietnam veterans who may have been exposed to herbicide contamination or radiation exposure in connection with the occupation of Hiroshima or Nagasaki in World War II or during atomic testing.

AMVETS is pleased to note that as of 5 April 1983, by VA Regulation, the medical service provided to radiation veterans under Section 610 is now coequal to that provided to herbicide exposed Vietnam veterans. That entitlement applies to any medical condition not attributable to a definite cause other than herbicide or radiation exposure. We commend the Administrator of Veterans Affairs, Mr. Harry Walters, for this prompt and compassionate response to the need of our atomic veterans.

Medical experience has demonstrated that the incubation periods for disabilities which may result from radiation exposure are often much longer than the presumptive periods now provided in the code. In order not to unjustly preclude deserving veterans from compensation, AMVETS advocates the enactment of an appropriate amendment to Title 38 to establish a rebuttable 25-year presumption of service connection for those disabilities which are determined to be epidemiologically connected with radiation exposure.

The other aspect of the radiation problem with which we are concerned relates to the precise epidemiological bases for possible compensable disabilities. AMVETS favors the enacement of Section 601 and 602 of S. 11, 98th Congress, as a badly needed effort to clarify the state of scientific knowledge of radiation induced disability. We also recommend a timely comparative statistical survey of atomic veterans medical problems by an agency independent of the VA. We oppose, however, any delay in the enactment of the 25-year presumptive period for radiation exposure pending completion of the epidemiological studies prescribed by S.11. AMVETS believes that sufficient medical knowledge now exists for the intelligent application of the presumption at least in connection with certain recognized malignancies. If the epidemiological studies should eventually negate our current understanding of the cause of certain disabilities, there will be time enough later to amend the law to exclude further compensation or medical treatment for those conditions. In the meantime, let's frame the law so as to give the benefit of doubt, if any to the veteran, while he and his family may yet derive some benefit from such legislation.

Finally, Mr. Chairman, AMVETS is pleased to note the passage in the Senate on 4 May 1983, of S.J.R. 68, the Resolution to honor atomic veterans on 16 July [illegible]983. We also commend the House Judiciary Committee for favorably reporting the resolution on 3 May 1983.

This concludes my testimony. I will be happy to answer your questions, if any.

STATEMENT OF
CHARLES E. JOECKEL, JR.
DEPUTY NATIONAL LEGISLATIVE DIRECTOR
DISABLED AMERICAN VETERANS
BEFORE THE
SUBCOMMITTEE ON OVERSIGHT & INVESTIGATION
OF THE
HOUSE VETERANS AFFAIRS COMMITTEE
MAY 24, 1983

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

On behalf of the more than three-quarters of a million members of the Disabled American Veterans , I wish to thank you, Mr. Chairman, for holding today's hearings to discuss the various issues relating to veterans exposed to radiation as a result of their participation in the atomic bomb detonation testing between 1945 and 1963.

There is no need here, Mr. Chairman, to recount the events which led up to today's hearing. Hearings held by your counterpart in the Senate on June 20, 1979 covered virtually every aspect of the controversy...e.g. claims processing; levels of radiation exposure; reconstruction of records; provision of health care; and the need for further scientific study. Little has changed.

GUIDELINES

As you know, Mr. Chairman, following the June, 1979 Senate hearings, the Veterans Administration adopted important guidelines relating to the adjudication of claims associated with exposure to radiation.

In our view, the implementation of these guidelines (VA Program Guide 21-1, Change 275, dated August 3, 1979) together with the Department of Defense and Veterans Administration Memorandum of Understanding on the Investigation of Ionizing Radiation Injury Claims and VA regulations concerning the development of such claims, provided a realistic means by which the establishment of service-connection for radiation related injuries and disease could be pursued.

In essence, these three documents allowed the VA to develop, to the greatest degree possible, individual veterans' claims relating to radiation exposure. In each instance, the Defense Nuclear Agency attempted to simulate the test site surroundings and develop exposure ranges for selected atmospheric test participant groups.

Using this information, the VA could then apply the provisions contained in the August, 1979 Program Guide.

Overall, the VA had some flexibility in allowing compensation benefits absent an in-service diagnosis or a finding of a compensable chronic disease or disability within one year from separation from active duty.

However, as you know, Mr. Chairman, these various guidelines were declared invalid by the U.S. District Court for the District of Columbia on September 30, 1981. Since that time, the Veterans Administration has had no choice but to consider such claims utilizing regulations which were in effect prior to September, 1981--which require in-service medical findings or the manifestation of a chronic disability or disease to a compensable degree within one year from the date of the veteran's discharge from active duty military service.

In compliance with the court's order, the VA printed the three guidelines in the Federal Register on October 27, 1982. The comment period ended on January 25, 1983.

Mr. Chairman, it was our hope that the use of these guidelines by the VA would assist in assessing the need for future legislative remedy. Accordingly, although valuable time has been lost, we favor the reissuance of the VA procedures for the adjudication of ionizing radiation claims as printed in the Federal Register on October 27, 1982.

HEALTH CARE

Mr. Chairman, it can be stated that radiation increases the incidence of many types of cancer, and the precise relationship between the incident and the dosage is not known for any type of cancer, especially at low radiation levels. The yield of tumor per unit dose cannot, therefore, be estimated nor can it be assumed that any amount of radiation, however, small, will increase the rate of cancer. Likewise, neither can it be assumed that a threshold exists below which no cancer can be induced.

Recognizing the health dilemma presented by low level exposure to radiation, the Congress passed legislation, now embodied in Public Law 97-72, extending VA health care benefits to veterans exposed to radiation. Yet, nearly eighteen months passed before revisions to the VA's regulations were processed to ensure that the treatment given to radiation exposed veterans is, at least, comparable with the health care provided to veterans exposed to various herbicides--Agent Orange in particular.

Reviewing the provisions contained in Section 102 of Public Law 97-72, Mr. Chairman, we note that VA health care may be provided "...notwithstanding that there is insufficient medical evidence to conclude that such disability may be associated with such exposure." In the case of veterans exposed to radiation, the evidence, with respect to high levels of radiation, is compelling but inconclusive that such exposure will cause cancer in every instance. With respect to low levels of radiation, the evidence is neither compelling nor conclusive.

While we are pleased that the VA recently clarified regulations concerning its policy to provide health care to veterans exposed to radiation, we believe that a distinction should be made, where possible, between exposure to high and low levels of radiation.

Accordingly, we suggest [illegible] cases where it is shown that a veteran was exposed to high levels of radiation and subsequently incurs [illegible] malignancy, VA health care should be provided on a basis similar to the care provided under Section 602 of Title 38, U.S. Code for certain impairments suffered by wartime veterans--so long as the malignancy was incurred within ten years from the date of separation from active duty military service.

Such a provision, in our view, would provide the assurance that veterans exposed to the highest levels of radiation--those with the greatest likelihood of incurring cancer--would receive VA health care services.

RADIATION STUDIES

Mr. Chairman, the National Executive Committee of the Disabled American Veterans recently adopted a resolution calling for the enactment of legislation which would authorize the Veterans Administration to conduct a study of the long-term adverse health effects of veterans exposed to ionizing radiation from nuclear detonation.

Our resolution envisions a statistical analysis, similar to that conducted by the National Academy of Sciences regarding cardiovascular conditions among amputees, to measure the relative risk of incurring a malignancy among veterans who participated in the atmospheric atomic and nuclear weapons tests from 1945 to 1962.

According to statistics that we have recently received from the Veterans Administration, from August 14, 1981 through December 1, 1982, the Veterans Administration considered some 1,982 claims relating to radiation exposure as a result of the nuclear weapons tests. Of the 1,982 claims filed, 793 veterans suffered varying diagnoses of malignancies.

As you are well aware, Mr. Chairman, the difficulty in establishing service-connection for conditions related to exposure to ionizing radiation centers around the fact that the scientific community has not positively linked exposure to low level radiation to the incurrence of malignancies. In addition, many of the medical records indicating the levels of exposure for individual veterans have been either lost, destroyed or not kept at all.

We think that the Veterans Administration should be required to contract for the study of the long-term adverse health effects of exposure to ionizing radiation from the detonation of a nuclear device in connection with the tests of such devices and with the American occupation of Hiroshima and Nagasaki during the period beginning September 11, 1945 and ending July 1, 1946.

In this connection, Mr. Chairman, the Disabled American Veterans respectfully requests that you give serious consideration to the enactment of legislation mandating the conduct of the statistical analysis noted in our National Executive Committee Resolution which proposes to assign a relative risk factor for the incurrence of cancer to various levels of radiation exposure.

ADVISORY COMMITTEE

Mr. Chairman, it has been five years since a House Subcommittee first focused attention on the nuclear bomb tests and the plight of veterans exposed to radiation. On various occasions since then, the Congress has brought attention to the issue by holding hearings in both the House and Senate--the latter concerning the communities "downwind" of the atomic tests.

However, Mr. Chairman, we believe that in terms of veterans benefits and services there should be single coordinated effort on the part of the Veterans Administration to formulate government policy concerning veterans exposed to radiation from all sources.

Accordingly, we propose that the VA establish an Advisory Committee similar to the VA's Working Committee on Agent Orange. Such a Committee comprised of veterans exposed to radiation and individuals who are recognized authorities in the field of radiation exposure research, would be a reliable resource for the government and Congress in assessing the needs of such veterans and their families with respect to compensation and health care benefits and on the prospects of rehabilitation.

ATOMIC VETERANS DAY

As you know, Mr. Chairman, Congressman Bob Edgar has introduced legislation (House Joint Resolution 210) which proposes to set aside July 16, 1983--the date commemorating the 38th anniversary of the first detonation of an atomic weapon--as a day to provide formal recognition to veterans who participated in the atomic weapons testing.

The Disabled American Veterans is pleased to support the efforts of the National Association of Atomic Veterans and the House sponsors of House Joint Resolution 210 to pay tribute to veterans who participated in the nuclear weapons testing.

As noted in the body of the House Joint Resolution, the DAV also believes "...that it is appropriate to have that day declared National Atomic Veterans Day in recognition of the importance of resolving issues related to the exposure of these veterans to ionizing radiation." Today's hearing is a step in this direction.

This concludes my statement, Mr. Chairman, and I wish to thank you and the members of the Subcommittee for allowing us this opportunity to present our views on this important subject.

STATEMENT OF JOHN F. SOMMER, JR., DEPUTY DIRECTOR NATIONAL VETERANS AFFAIRS AND REHABILITATION COMMISSION THE AMERICAN LEGION TO THE SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS COMMITTEE ON VETERANS AFFAIRS U.S. HOUSE OF REPRESENTATIVES

MAY 24, 1983

Mr. Chairman and Members of the Subcommittee:

The American Legion appreciates the opportunity to present to this Subcommittee its views on the problems that are being incurred by veterans exposed to ionizing radiation while serving on active duty in the United States Armed Forces. They are now finding it exceedingly difficult to receive favorable results on their disability compensation claims from the Veterans Administration, and medical care based upon the provisions of Public Law 97-72 from VA medical care facilities.

The American Legion has made known the fact that we have considered the guidelines for the provision of medical treatment to veterans exposed to ionizing radiation that were published and implemented subsequent to the enactment of PL 97-72, to be too restrictive. The criteria contained in Department of Medicine and Surgery Circular 10-82-246, provided eligibility for treatment only to those exposed veterans who had developed cancer and thyroid nodules; the only conditions that the Veterans Administration feel are caused by radiation exposure. As previously mentioned the Legion has stated that until more is known scientifically about what additional diseases and disabilities are actually caused by radiation exposure, the guidelines should be expanded to the point of being equivalent to the criteria used to provide VA medical care to Vietnam veterans exposed to

Agent Orange, particularly since the eligibility for the provision of treatment of both groups of veterans was established under the same law.

Having said that, we were pleased to hear the announcement on April 6, seventeen months after the enactment of PL 97-72, that the Veterans Administration has agreed to liberalize its guidelines to provide medical treatment to these former military personnel who were exposed to radiation and whose illnesses may well have been caused by such exposure.

DM&S Circular 10-83-61, officially signed on April 5, contains more liberal guidelines for providing medical treatment to these veterans. While The American Legion is appreciative of this change of policy on the part of VA, we are going to closely monitor the implementation of these guidelines to ensure that radiation exposed veterans are receiving the medical treatment and hospital care to which they are rightfully entitled.

The Legion would support a legislative proposal to amend chapter 17 of title 38, United States Code, to provide a presumption of service connection for treatment purposes in the case of a veteran exposed to radiation while serving on active military duty, and who has incurred a malignancy within ten years following separation from such service.

Mr. Chairman, we recently appeared before the Senate Veterans Affairs Committee in support of a proposal that would require the Veterans Administration, through contract, to conduct an epidemiological study of the long-term adverse health effects of ionizing radiation on those veterans exposed to it while serving on active military duty during nuclear weapons testing, or during service with the occupation forces in Hiroshima and Nagasaki following World War II.

The proposal would further require the Veterans Administration to conduct a comprehensive review and analysis of the literature covering studies which have been completed, or are currently underway relating to the long-term adverse health effects in humans of exposure to radiation, including nuclear device, medical, and occupational exposures.

Various estimates have been made regarding the total number of veterans exposed to radiation, ranging from 220,000 to 350,000. Regardless of the exact figure, we are speaking of a significant number of veterans who were present during nuclear weapons tests during the period 1945-1962. Many have subsequently developed leukemia and other similar diseases which may be linked to their exposure to radiation.

It is interesting to note that a Centers for Disease Control study of the veterans present at the Nevada test site for shot SMOKY has identified an increased incidence of leukemia. However, CDC has been reluctant to attribute the leukemia to radiation exposure. The American Legion would like to know if exposure to radiation from the test did not cause the increase in leukemia cases then what did? The Defense Nuclear Agency claims that the findings of the SMOKY study are the only indication that there may be an increased health risk associated with test participation.

We should not be surprised, since to our knowledge it is the only detailed study of a shot that has been completed to date.

As for the veterans of Hiroshima and Nagasaki, according to DNA figures the occupation force for that part of Japan following surrender initially totalled some 240,000 troops. On February 20, 1980, the Director of the Defense Nuclear Agency requested that the National Academy of Sciences advise him on the feasibility and desirability of performing epidemiological studies on the U.S. military personnel who served in the occupation forces in Hiroshima or Nagasaki. The NAS issued a report on August 21, 1980, and we have noted with interest some of the language contained therein. For example, in the preface to the report it is stated "The charge to the panel did not include risk assessment but covered only the feasibility and desirability of performing studies on this group of veterans. The panel felt that the data available were sufficiently firm to enable an evaluation of the problem."

In the NAS report itself, it is stated "However, the Committee for U.S. Veterans of Hiroshima and Nagasaki has alleged, albeit on rather uncertain grounds, that the prevalence of multiple myeloma has been disproportionately high among U.S. Hiroshima and Nagasaki veterans who have filed claims for compensation. Other populations exposed to large doses of ionizing radiation - for example early American radiologists and Japanese A-Bomb survivors - have been reported to have an increased frequency of this disease. It has not been established, however, that there is actually an increase in the incidence of this or other potential radiation-related diseases in the early-entrant veteran population.

"The Panel believes that a scientifically valid study of morbidity among Hiroshima and Nagasaki veterans would be impractical, because systematic information on hospitalization is lacking and it is difficult to locate veterans 35 years after the fact. But a study of mortality among these veterans would be feasible, albeit costly."

The panel concluded its report by stating the following points:

"(1) Scientifically sound studies of morbidity among military personnel who entered Hiroshima or Nagasaki soon after the bombings are impractical. Records of morbidity in this population are just not available nor could they be assembled in any objective or systematic fashion.

"(2) Studies of mortality among these men are feasible. However, from a strictly scientific point of view, such studies appear to carry inordinate cost in relation to the potential benefit.

"(3) No study of the population in question could detect effects that would be predictable from existing knowledge of health hazards associated with radiation exposure.

"(4) The possibility that multiple myeloma is occurring in excess in these veterans, as has been alleged, should be explored. This should not at first involve a full-scale epidemiologic study. The number of confirmed cases of the disease in this population should first be determined, and an evaluation made as to whether this is

> excessive before any further studies are recommended. As we have implied earlier in this report, even if an excess number of cases of multiple myeloma is present in this population, it is unlikely to be attributable to ionizing radiation."

To The American Legion, much of the reasoning used to draw these conclusions is questionable. How does one determine the relationship between cost and potential benefit - unless the potential benefit is predetermined - as in the statement that "even if an excess number of cases of multiple myeloma is present in this population, it is unlikely to be attributable to ionizing radiation."

There is a wide difference of opinion among the scientific community as to how much radiation is dangerous. However, the Federal Government is holding fast to the theory that any exposure under 5 REMs is not harmful.

For all of these reasons, The American Legion strongly believes there is a definite need for an epidemiological study to determine the effects of radiation exposure. A statistical study conducted in conjunction therewith should also prove to be helpful in determining increased incidences of diseases that may be caused by radiation exposure.

Mr. Chairman, as we previously mentioned, The American Legion has found it exceedingly difficult to obtain favorable action on claims to VA for service-connected compensation based upon disabilities felt to be caused by radiation. Figures available to the Legion show that as of March 1, 1983 a total of 3,325 radiation exposure claims had been evaluated by the Department of Veterans Benefits, and of those 2,321 cases related to a diagnosed condition. In 69 of these cases service connection was granted. Atomic testing exposure was claimed in 2,067 of the cases, 1,480 of which contained a diagnosis. A total of 14 atomic weapons testing cases had been allowed as of that time. For the purpose of comparison, the figures break down to an allowance rate of 3 percent of the total cases involving a diagnosed condition, and 0.7 percent of the atomic test related cases with diagnoses.

We have for several years been actively involved in attempting to locate veterans who participated in any of the some 235 atmospheric nuclear weapons tests while on active duty, and assisting such veterans in the filing and development of claims for benefits under laws administered by the Veterans Administration. VA has been hesitant to demonstrate any degree of flexibility when considering the evidence of record in radiation claims, as reflected by the small number that have been allowed.

The American Legion is mandated by Resolution No. 409 of the 1982 National Convention to urge the Administrator of Veterans Affairs to promulgate regulations and issue additional specific guidelines and instructions to all regional offices necessary for the proper development and adjudication of claims involving disabilities resulting from exposure to radiation. This may be accomplished as the result of litigation. The current VA guidelines were challenged in the United States Court for the District of

Columbia in a case called Gott vs. Nimmo. Plaintiffs claimed that the VA Program Guide and a Memorandum of Understanding between VA and the Defense Nuclear Agency were government policies that had been implemented without the public comment required by the Administrative Procedures Act (the VA defended the suit by saying that the documents were simply information and not policy). The District Court ruled in September 1981 that the documents were rules and the VA had to either rescind them or publish them for comment under the Administrative Procedures Act. The VA has published the documents while it has appealed the decision to the Court of Appeals. The case was argued in the Court of Appeals in December and the decision is forthcoming.

The important issues in this case are the contentions of the plaintiff:

1) That cancer and other diseases are caused by exposure to less than 5 REMs of radiation, supported by the SMOKY study that shows leukemia is caused by exposure to less than 5 REMs of radiation.

2) DNA exposure estimates generally say that veterans very close to test sites received very little radiation. This is inconsistent with the claims of veterans and findings of the government that civilians hundreds of miles away received high doses of radiation. DNA estimates are based partially on film badges which do not measure some of the types of radiation particles and the radiation inhaled or ingested.

The American Legion, at the request of the General Accounting Office, also recently assisted in an attempt to contact veterans who were involved in atomic weapons testing at the Nevada test site in the mid-1950's, and have any knowledge of radiation exposure records of military personnel being falsified, as has been alleged. We understand that the investigation has been completed, and the results of this GAO study will be forthcoming in the near future.

There is much that needs to be done in the way of research and the establishment of government policy to adequately address the real concerns of radiation exposed veterans and their families. Hopes have been raised based upon statements by the government during Congressional hearings on the radiation issue. However, the Legion has seen little change in the attitude or policies of the Veterans Administration or other government agencies that are involved with the issue. It would appear there is a need to consolidate the available information on the effects of low level radiation on veterans and to focus additional attention on the subject. Perhaps the establishment of an Advisory Committee on Atomic Veterans within the Veterans Administration is needed to accomplish this and to develop comprehensive regulations, guidelines and standards for the development and adjudication of claims.

There is clearly a need for action to be taken, and The American Legion urges the Congress to study this matter, keeping in mind the plight of the veterans involved and the frustrations they face in attempting to secure benefits for and treatment of their disabilities.

Mr. Chairman, a joint resolution, H.J.R. 210, was recently introduced, which if enacted would authorize and request the President to designate July 16, 1983 as "National Atomic Veterans Day." The date of July 16 is significant, as it is the anniversary of Trinity, the first detonation of an atomic weapon, at Alamogardo Air Force Base, New Mexico on July 16, 1945. The American Legion feels it appropriate that these veterans, because of their patriotic service under hazardous conditions, and the resulting problems they have faced in the years subsequent to discharge, should be recognized and honored in such a manner, and we support the intent of H.J.R. 210.

Mr. Chairman, that concludes our statement, and we would again like to express the appreciation of The American Legion for the opportunity to present our views on this important issue.

MAY 19 1983

MAY 19 1983

NATIONAL ASSOCIATION OF
RADIATION SURVIVORS
VETERANS, CIVILIANS, VICTIMS, FRIENDS

231 27th Street
San Francisco, CA. 94131
(415) 652-4400; Ext. 441

RE: Oversight Hearings
Veterans Affairs Committee
House of Representatives

May 26, 1983

Honorable Chairman Mongomery, and Members of the Committee:

My name is George W. Seabron, and I am the President of the National Association of Radiation Survivors, Inc.

I am pleased to prvide testimony today, but in the opinion of many of us in NARS, dollars are being wasted in this hearing. If the Veteran's Administration would simply adhere to Title 38, there would be no need for this hearing.

1. Title 38 states that if there is reasonable doubt in any claim, the claim should be awarded to the veteran. At the bottom of each claim form, a quotation, taken from Abraham Lincoln notes, "We take care of our own".
2. I have compiled a series of questions, taken from our membership, to this Committee. They include:
    - a) Out of over 2000 radiation claims filed, why have only approximately 15 been approved?
    - b) What is the rationale for those who have been approved, when nearly identical claims have been denied?
    - c) Isn't the fact that there were 662 Cancerclaims among the 2000-odd radiation claims an indication of "reasonable doubt", since it is well-documented that radiation causes cancer?
    - d) Why does the Government subsidize medical students who study in South America, and not in Japan, where radiation medicine is advanced?

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Litigation Director: Charles Tergen

e) We have a series of questions on Operation Crossroads, where the majority of our deceased NARS veterans participated:

1) Of the 42,000 personnel at Crossroads, How many have had medical surveillance by the Government?

2) Of the 5000 rats, 200 pigs, and 204 goats at Crossroads, how many had medical surveillance/testing by the Government?

3) What were the findings on the exposed animals? We know these same illnesses occurred in the humans there.

4) Since we know that several ships at Crossroads took on contaminated salt water from the Bikini Lagoon, which was treated by evaporation and then ingested, there was internal exposure of personnel. Was this ever monitored?

5) All of our Bikini veterans of Crossroads,or their widows, can state that there was no warning of possible health effects, even until today, on the part of the Government. It is in the literature, all scientist admit such effects, though they are split on dose required for certain effects. Why, then, is there no medical surveillance?

I say to you, Mr. Chairman, those of us in the trenches or aboard ships at sea, or innocently "Downwind" did our part for world peace, as did our combat veterans. We were sent on our way without fanfare, and without warning. Our Government forgot to tell us that we have a good chance of suffering "delayed radiation effects". Our claims for compensation have been turned down by the VA.

Japan is taking care of its victims medically and with compensation. When will our Government do likewise?

Respectfully submitted

George W Seabron

G. W. Seabron, President
National Association of Radiation Survivors

NATIONAL ASSOCIATION OF
RADIATION SURVIVORS
VETERANS, CIVILIANS, VICTIMS, FRIENDS

231 27th Street
San Francisco, CA 94131
(415) 652-4400; Ext. 441

PREPARED STATEMENT BY ELEANORA WOODIS MILLS
WIDOWS REPRESENTATIVE

TO: Chairman Montgomery and Members of the House Veterans Affairs Committee

I am aware that other Senate and Congressional hearings have been held on atomic veterans claims for disabilities from nuclear weapons testing, and the testimony from individual widows has been presented. However, never has an atomic veterans widow representing 200 other widows of atomic widows, primarily from California, been present to participate on their behalf at such hearings.

It is my intention to correct this "oversight", and as the elected representative of the National Association of Radiation Survivors, I am submitting to this Committee the facts and documentation from a questionnaire to these 200 widows of atomic vetereans.

I am requesting that this entire statement be read and become a part of the permanent record of this hearing.

Table I Data from Atomic Widows (Questionnaire sent to 200 widows)

CAUSE OF DEATH: CANCER

Leukemia	20%
Lymphoma	12%
Melanoma	10%
Lung Cancer	7%
Brain Cancer	5%
Other Cancers	34%
OTHER	14%

(Candida, Heart Attack, Nephritis, Aneurysm of Aorta, etc.

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[illegible]
Parliamentarian: Dale Crawford
Communications: [illegible]

Advisory Board
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[illegible], J.D.
[illegible], J.D.
[illegible], M.D.
[illegible], M.D.
Henry Vyner, M.D.
[illegible], Ph.D.
Litigation Director: [illegible]

Testimony of Eleanora Woodis Mills, NARS Widows Representative
Table 1 (Concluded)

DISEASE DIAGNOSIS: EARLY/LATE.........All diagnosed late, within one year of death-18 months

AVERAGE AGE AT DEATH..........50 (Range: 27-62)

PROOF OF PRESENCE AT SHOT......52% has no proof pf presence

PROOF OF EXPOSURE ....95% had no Radiation Reading (most husbands from Bikini, 1946)

VA CLAIM STATUS

Length of Claim before Adjudication.......4½ years (range: 1-8 years)

NUMBER WINNING VA CLAIM.................................One Widow

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The atomic widow has had many burdens to bear, but the most intolerable burden is the "burden of proof", in which she must prove that her late husband was physically present at an atomic detonation. She will learn that records do not exist, or if they did at one time, they do no longer, because of improper record keeping. She should not be held responsible for the irresponsibility of the Government in filing and keeping of records. If there is a "benefit of the doubt", it should be extended to her. This is not the case. She is expected to provide the documentation and proof of presence, locate his service and medical records, dosimeter readings, and so on.

When a VA claim is filed, it will take years to process and the regional offices will make their determinations. When the widow appears for a personal hearing, she should know that the tapes recording her testimony are erased and reused, so that once the transcript of the hearing is typed, the errors and omissions cannot be corrected.

When the claim is remanded from the Bureau of Veterans Affairs back to the regional office, part of the remand instructions will call for a visit fromthe Field Examiner. He is provided with a copy of the specific Questionnaire for the Field Examiner. Unless the widow is provided with this same document in advance, there is no way she can truthfully answer such questions.

Furthermore, unless the late veteran discussed his experience in detail, an unlikely occurrence, as he was bound by secrecy and subject to court-martial, how would she know, for example, whether he walked toward or away from ground zero, how long he remained in the vicinity, how close he was, and so on. Since the Field Examiner record becomes part of the testimony and part of the widow's file, this policy should be eliminated. It is totally unfair to the widow.

Finally, undue hardship is placed upon the widow of an atomic veteran, as ultimately, VA awards are made in Washington. In order to present her case to the Board of Veterans Appeals, she must travel there at ther own expense.

This concludes my statement.

Sincerely,

Eleanora Woodis Mills

Eleanora Woodis Mills, Widows Representative
National Association of Radiation Survivors
Post Office Box 1063
Twentynine Palms, CA. 92277

NATIONAL ASSOCIATION OF
RADIATION SURVIVORS
VETERANS CIVILIANS VICTIMS FRIENDS

231 27th Street
San Francisco, CA. 94131
(415) 652-4400; Ext. 441

RE: Congressional Oversight Hearings
Veterans Affairs Committee
Attn: Chairman Montgomery

Dear Congressman Montgomery,

I am writing to urge the inclusion of studies of the Adverse Birth Outcomes experienced in the families of the Atomic Veterans exposed to ioning radiation in the Nuclear Weapons Testing Program. I include the results of an informal miled questionnaire survey which our association coded based on returns from 500 atomic veterans. Though not a scientifically-sound study, it does point up the need for additional research in this area. I wold like to suggest that your Committee support a companion bill to Senate Bill 11, which mandates such genetic research.

Thank you for your attention to this important issue.

Sincerely,

Dorothy Legarreta

Dorothy Legarreta, Ph.D.
Administrative Director

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NATIONAL ASSOCIATION OF
RADIATION SURVIVORS
VETERANS CIVILIANS VICTIMS FRIENDS

PILOT STUDY ON ADVERSE BIRTH OUTCOMES OF ATOMIC VETERANS

The pilot study on the Adverse Birth Outcomes (Genetic Defects and Cancers) found in the children of Atomic Veterans consisted of drawing out the 100 questionnaires from the NARS Health Survey in which such diseases or defects were noted. These were coded in categories by disease or defect, using the ICD system. The denominator used was the Total Live Births in the entire sample after exposure. The results appear in Table I.

TABLE I

ADVERSE BIRTH OUTCOMES REPORTED BY 500 ATOMIC VETERANS

TOTAL LIVE BIRTHS AFTER EXPOSURE:	1045
TOTAL MISCARRIAGES AFTER EXPOSURE:	135
LIVE BIRTHS WITH ADVERSE OUTCOMES:	18%

SAMPLE OF 100 REPORTING ADVERSE OUTCOMES

TOTAL LIVE BIRTHS	345
TOTAL MISCARRIAGES	44
STILLBIRTHS/EARLY DEATH	23
NUMBER OF LIVE BIRTHS WITH ADVERSE OUTCOMES	192
TOTAL NUMBER OF ADVERSE OUTCOMES	275

Congenital Defects:

Internal Organs:	35
Appendages	24
Bone	42
Heart	17
Blood	3
	120

Other:

Neoplasms (Cancers, Tumors):	36
Mental Retardation	22
Epilepsy	8
Cerebral Palsy	3
Sterility	5
Eye Problems	26
Deafness	2
Psychiatric Illness	12
	114

Miscellaneous (Muscle, Skin, etc.): 43

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Radiation
Research
Institute

March 31, 1983

The Radiation Research Institute (RRI) is a tax-exempt, nonprofit organization that provides free medical care to atomic veterans and other radiation-exposed persons. The Institute has been conducting clinical evaluations on atomic veterans for three (3) years.

The following testimony is an overview of the medical problems encountered by the atomic veteran and gives recommendations for a new clinical approach to these problems. Two(2) atomic veteran case histories are also presented.

Please feel free to contact the Radiation Research Institute if you have any questions or if you would like further information about our ongoing work.

Sincerely,

Susan D. Lambert, M

Susan D. Lambert, MD, MPH

[illegible] fulton street suite [illegible] berkeley, california 94704 [illegible]

Radiation
Research
Institute

March 31, 1983

The Radiation Research Institute has conducted numerous medical examinations on atomic veterans over the last three(3) years. It has become increasingly apparent to us that many atomic veterans have physical symptoms that are inconsistent with the clinical pictu of any recognized disease. These unexplained symptoms have been deal with by the Veterans Administration(VA) in one of four(4) ways:

1) The atomic veteran is thought to have a psychosomatic disease
2) He is diagnosed as hypochondrical.
3) The symptoms are misdiagnosed in an attempt to find the disease of "closest fit".
4) The symptoms are regarded as part of an unknown disease process and treated symptomatically.

Medical science accepts that certain cancers, leukemia, cataracts(posterior-subcapsular), and genetic defects can be caused by ionizing radiation. Within the context of ionizing radiation, the medical model is, for the most part, a disease-oriented model. More specifically, the medical literature on the delayed health effects of ionizing radiation centers on carcinogenesis.[1,2,3] The Federal Register(December 31, 1980) states that "cancer is the major disease associated with radiation exposure".

The assumption that cancer is the major adverse health effect secondary to ionizing radiation may, in fact, prove to be misleading Noncancerous diseases are generally disregarded despite the considerable medical literature to support that ionizing radiation can cause, for example, damage to the immune system[4] and can accelerate the aging process.[5,6,7] Understandably, the parameters of the immune system and the aging process are difficult to monitor clinically, but to disregard their importance could prove to be a serious omission.

[illegible] Fulton Street Suite [illegible] Berkeley, California 94704 [illegible]

The Radiation Research Institute recommends that a broader overview of delayed effects of ionizing radiation be considered. To do this, it is useful to note the Russian-language translation of the Remote Aftereffects of Radiation Damage.[8] In this translation series a disease-process model of cancerous(tumorous) and noncancerous(nontumorous) forms of delayed radiation effects is presented (See Appendix A). This model is based on the process of disease, rather than on the disease entity itself. It gives equal importance to cancerous and noncancerous forms of delayed radiation effects. Both of these forms are seen as developing against a background of distinct blood vessel impairment.

This disease-process model characterizes the noncancerous delayed effects by three(3) distinct processes:

1) APLASTIC AND HYPOPLASTIC STATES:
This process is characterized by a total lack of development or an underdevelopment of a tissue, particularly of the blood-forming tissues (eg. bone marrow), the mucous membranes of the gastrointestinal tract and the sex organs.

2) SCLEROTIC PROCESSES:
This process is the substituting of fibrous (sclerotic) tissue for normal tissue rendering the tissue dysfunctional or completely nonfunctional. This can be seen in organs such as the lung, liver and the blood vessels.

3) DYSHORMONAL STATES:
This is the process characterized by depression and/or damage of the function and structure of the sex glands, the thyroid and the adrenal glands.

* * *

The following is a presentation of two(2) atomic veterans who have unexplained symptoms. They are both examples of an unknown number of atomic veterans who are manifesting a cluster of symptoms that include muscle pain and weakness often aggravated by activity.

Sometimes these symptoms are transient in nature, lasting from days to weeks, with remissions also lasting from days to weeks. The noteworthy feature of these symptoms is that they are often disabling and can profoundly affect the quality of life of the veteran. These men have often seen several physicians in their search for a diagnosis, but more often than not, the disease is not diagnosed. A number of these men have undergone thorough neurological evaluation, including electromyograms, nerve conduction studies and muscle biopsy. No conclusions can be drawn from these clinical evaluations to date.

CASE #1

Mr. X is a 55 year old white male who developed muscle aches and pains in 1958. He describes a profound pain to his arms and legs that is aggravated by minimal physical exertion. When the pain occurs it is of a constant nature and it severely interfers with his ability to stand or walk. The pain has now precluded him from working in his own store.He states that the pain has affected his whole life to the point where he greatly fears he will not be able to ever live a normal life again.

Mr. X also complains of episodes of profound weakness which began about 9-10 years ago. This was first noted upon combing his hair when the comb flew out of his hands. He also noted difficulty holding a toothbrush. The weakness has since progressed to the point where he now has difficulty opening bottles, lifting his arms above his head, and climbing stairs. He began to develop weakness to his legs about 4-5 years ago. This was first noted after the veteran had walked all day with his children at an amusement park. That night in his motel room, he couldn't move due to severe pain and weakness. These symptoms were so profound that he needed assistance in using the bathroom. This particular episode of pain and weakness persisted for two weeks.

In December 1979, the veteran was seen by his physician. He was found to have normal nerve conduction studies but an abnormal electromyogram--- the latter showing evidence of denervation of muscle fibers.

On ischemic exercise testing he failed to show a rise in the serum venous lactate levels. Creatine phosphokinase levels were slightly elevated during ischemic exercise testing.

The abnormal electromyogram and ischemic exercise test were suggestive of a metabolic myopathy, and the veteran underwent his first muscle biopsy in March 1980. The results were a clearly abnormal biopsy of uncertain significance. A myelogram, creatine phosphokinase, and a CT scan were all normal.

Due to a difference in opinion regarding the first muscle biopsy, a second muscle biopsy was done in April 1981. The results were reported as nonspecific abnormalities.

The veteran was seen at the Radiation Research Institute in July 1981. His complaints of muscle pain and weakness had progressed. The neurological examination was essentially normal (as it had been in the past), except for some bilateral proximal weakness in the upper and lower extremities. He underwent a third muscle biopsy, this one utilizing 17 different histochemical stains. The biopsy was again abnormal showing nonspecific features including clustering of type II fibers and multiple central nuclei.

Mr. X is a 35 pack-year smoker. He used to be a heavy drinker but now only drinks occasionally. He has essential hypertention which is controlled by diuretics and beta blockers. There is no family history of dystrophies or any neuromuscular disease.

Military history reveals that Mr X. entered the Navy in his late teens. He participated in Operation Crossroads (Tests Abel and Baker) in July 1946. A second exposure to ionizing radiation took place in 1960-61 when he took x-rays of Air Force servicemen for discharge physicals. He states that he did about 300-400 x-rays, sometimes without lead shielding. He has no occupational history of exposure to ionizing radiation nor chemical substances.

The exact nature and causation of Mr. X's illness is unknown.

CASE #2

Mr. Y is a 56 year-old white male who complains of pain in his legs that began in his early twenties when he was in the U.S.Navy. Over the last 2-3 years the pain has become progressively worse. The pain is constant in nature and is present 24 hours a day. It is clearly aggravated by activity, and at times he is unable to walk for more than 1 or 2 blocks at a time. He describes the pain as a squeezing sensation, often requiring hours to days before reasonable recovery from the acute episodes. There is no involvement of the upper extremities. He denies muscle weakness, paralysis, muscle twitching and hypanalgesia. He denies pigmenturia. Heat and temperature do not alter the pain, nor does massage. There is no family history of myoglobinuria nor any neuromuscular disease.

Because of the continued pain and a possibility of claudication, Mr. Y underwent arteriography of the legs in May 1982, which revealed no significant abnormality. A lumbar myelogram of October 1980 failed to show any specific abnormality.

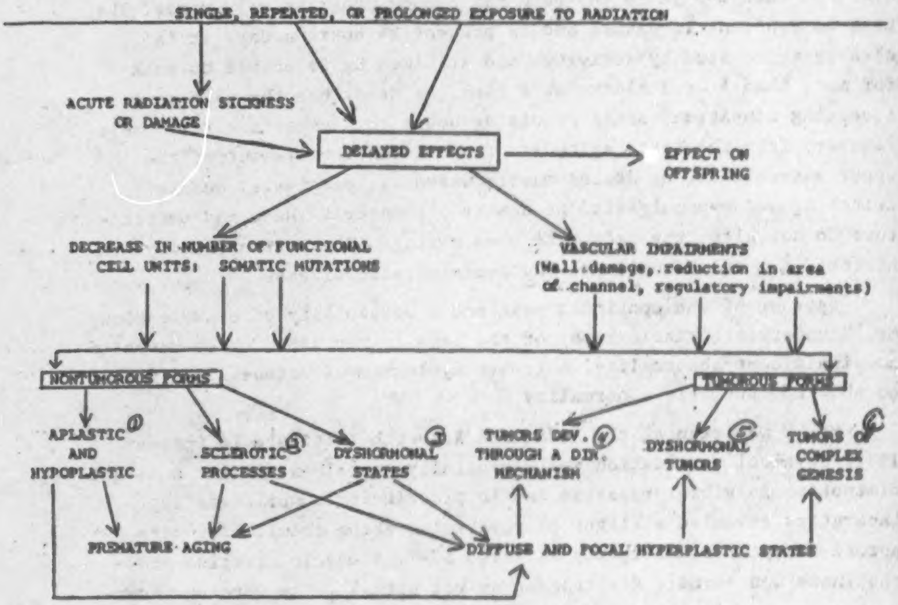
Mr. Y was seen at the Radiation Research Institute in October 1982. Physical examination was essentially normal except for a slight diminution in vibratory sense and in proprioception bilaterally. Laboratory revealed a slight polycythemia. Serum chemistries were normal except for a slightly elevated SGPT. A muscle creatine phosphokinase was normal. Electromyogram was normal. The veteran underwent a muscle biopsy on October 18, 1982 which revealed a mild type II atrophy. These are nonspecific findings. An ischemic lactate test is pending.

Mr. Y is a 35 to 52 pack-year smoker. He drinks 1-2 cocktails a day. He has hypertension controlled by a diuretic. Military history reveals that he was in the Navy from 1944-63 when he participated in Operation Sandstone. Occupational history reveals no radiation nor chemical substance exposure.

The exact nature and causation of Mr. Y's illness is unknown.

APPENDIX A: DISEASE PROCESS MODEL OF DELAYED EFFECTS:

(From Moskalev, Yu. I, ed. Remote Aftereffects of Radiation Damage, Atomizdat, Moscow, 1971.)


SINGLE, REPEATED, OR PROLONGED EXPOSURE TO RADIATION
ACUTE RADIATION SICKNESS OR DAMAGE
DELAYED EFFECTS
EFFECT ON OFFSPRING
DECREASE IN NUMBER OF FUNCTIONAL CELL UNITS: SOMATIC MUTATIONS
VASCULAR IMPAIRMENTS (Wall damage, reduction in area of channel, regulatory impairments)
NONTUMOROUS FORMS
TUMOROUS FORMS
APLASTIC AND HYPOPLASTIC ①
SCLEROTIC PROCESSES ②
DYSHORMONAL STATES ③
TUMORS DEV. THROUGH A DIR. MECHANISM ④
DYSHORMONAL TUMORS ⑤
TUMORS OF COMPLEX GENESIS ⑥
PREMATURE AGING
DIFFUSE AND FOCAL HYPERPLASTIC STATES

1. Panmyelophthisis, anemias of different types; atrophic; hypoplastic states of G.I. (gastrointestinal) tract; partial or complete sterility, etc.
2. Cirrhosis of liver, nephrosclerosis, pheumosclerosis, dermatitis, keloids, arteriosclerosis, nodular periarteritis, damage to CNS with proliferation of glia and connective tissue, and cataracts.
3. Estrogenism, aldosteronism, parathyreocrinal syndrome, thyroid inadequacy and hyperfunction, etc.
4. Tumors of bones, liver, kidneys, lungs, connective tissue, skin.
5. Dyshormonal tumors of the uterus, overy, prostrate, sex organs, and organs of internal secretion.
6. Tumors arising as a result of combined direct and dyshormonal mechanisms - leukosis, mamary gland tumors, etc.

8711 Hidden Hill Lane
Potomac, Md. 20854
May 21, 1983

Honorable G. V. (Sonny) Montgomery
United States House of Representitives
Committee on Veterans' Affairs
335 Cannon House Office Building
Washington, D.C. 20515

Dear Congressman Montgomery:

Thank you very much for allowing me to submit the enclosed statement for inclusion in the record of the May 24, 1983 hearing before the Committee on Veterans' Affairs Subcommittee on Oversight and Investigations.

For the past five years I have been attempting to convince the Veterans' Administration that my mother's claim for Dependency and Indemnity Compensation is valid. Her claim cites my father's participation at Bikini Atoll and his death in 1977 from polycythemia vera. While our claim has been denied, we firmly and honestly believe it is meritorious and that the case record supports our conclusion.

The Board of Veterans' Appeals has been resolving claim disputes for years and there is a natural inclination not to fiddle with a dispute resolution process that is working. Unfortunately, I believe the process has not worked in our case, and fear that we may not be unique. I am concerned that the Board decided our case before all the facts were presented and may have focused its attention on matters unrelated to our claim. We are fully aware of the consequences, personal and political within the Veterans' Administration, of admitting error and reversing a prior position, especially in an area perceived to by highly sensitive. We have not attempted to interject these factors into the record in our case, because they involve conjecture and cannot be proved. What has been shown, however, is that the Board totally ignored carefully researched legal arguements and factual contentions. At an absolute minimum, such a situation is cause for concern. Especially when you consider that the Board's decision is unreviewable, even by the Administrator of Veterans' Affairs.

Mother and I believe we have been fair, honest and straightforward in our dealings with the Veterans' Administration. We can not prove that the Veterans' Administration has not been honest with us. The facts demonstrate, however, that it has been neither straightforward or fair. We feel very abused by the Veteran's Administration and appreciate the opportunity to submit the enclosed statement which explains why.

Sincerely,

Lawrence D. Garr

LAWRENCE D. GARR

I would like to thank Congressman Larry Coughlin and the Committee Chairman, Congressman G. V. (Sonny) Montgomery for allowing me to submit testimony in connection with this hearing. My name is Lawrence D. Garr and my father, Herbert Garr, was a participant at Operation Crossroads in July of 1946. My mother, Anne W. Garr, and I contend that dad's death from polycythemia vera (PV) resulted from his exposure to ionizing radiation at Bikini Atoll. All the facts and and legal contentions that will be made today are documented in a Brief and Supplemental Brief which were submitted to the Veterans Administration (VA) and are of record in the case of Herbert Garr, XC 10 504 088.

On November 23, 1982 the Board of Veterans Appeals (BVA) denied on reconsideration our claim for Dependency and Indemnity Compensation. Mother's claim was originally turned down at the local level. It was said she had not proved her husband was exposed to radiation, or that low level radiation can cause "disabilities occurring at remote dates." We appealed and submitted to the BVA evidence of radiation exposure and reports from medical experts which concluded there likely was a causal link between PV and radiation exposure. On December 12, 1980, the BVA turned down mother's claim saying PV's easy diagnosis made the total lack of epidemiological data linking PV to radiation determinative. Radiation exposure was conceded, but not the amount.

The evidence before the BVA included a letter dated February 11, 1980 to it from the Centers for Disease Control (CDC) reporting a "very suspicious" ten fold increase in PV among the veterans studied in the Smoky bomb test, the only test that has been studied by the CDC to date. Other articles by medical experts which were attached to the CDC letter explained that PV is often hard to diagnose and is similar to various diseases which studies have shown are caused by radiation. The articles were inconsistent with and conspicuously absent from the BVA's written analysis. It would appear they were simply overlooked, which is not surprising considering their length, complexity, and the fact that only selected portions were relevent to the point at issue.

We asked the BVA to reconsider our claim and in March of 1982 submitted a brief listing 15 major errors of fact and law. At that time we also submitted epidemiological evidence from Hiroshima which was sufficient to lead a committee of experts to conclude that PV, along with leukemia and four other blood disorders could be caused by radiation exposure. Then, on August 5, 1982, we sent the BVA a newspaper article from the Philadelphia Inquirer entitled "Rare disease probed near S.C. nuclear plant." It detailed an unexpected outbreak of PV among employees of the plant and a CDC doctor's statement that it was "reasonable to assume" there was a causal link between radiation exposure and PV.

The BVA wrote back saying it would not consider any evidence received after December 12, 1980, but such evidence could be used as a basis to reopen the claim. The failure to consider this evidence is unsupportable as a matter of law or policy. In a supplemental brief we explained that were a new medical study to rule out any possibility of a relationship between radiation and polycythemia vera, we would not expect the BVA to grant relief in mother's favor. We are confident that not one member of Congress intended the Board to approve claims on reconsideration, and thereby authorize the payment of thousands of taxpayer dollars, in cases where current medical developments establish that the claimants are clearly not entitled to the benefits. Such action would hardly be consistent with the BVA's obligation to protect the interests of the Government. Neither mother nor the interests of the Government would be harmed, however, were the BVA to render a medically informed decision. Conversely, by its refusal to consider current medical opinions and the general data upon which they are based, neither mother nor the Government benefited. Our argument was apparently rejected. On this point the BVA did not attempt to provide an explanation. In fact, it did not even acknowlege that the legal argument had been made.

On November 23, 1982 the BVA again turned down mother's claim. It dismissed the evidence of radiation exposure saying "on the basis of a longitudinal review of the evidential record, it has not been demonstrated that the level of exposure was substantial or high." The Board did not explain how they were able to discount so easily and completely the evidence of exposure assembled in our brief. On the same evidence the December 12, 1980 decision conceded radiation exposure. We now have no idea what it conceded in 1980, and I suspect the Board doesn't either.

We are disappointed, but not surprised the BVA failed to discuss the factual allegations or legal arguments set forth in our briefs. The briefs were not filed until mother and I were confident they were accurate, and did not overstate our position. We are not lunatic protesters, and we hoped to be taken seriously.

The BVA said it endeavored to explain "quite clearly" that it considered the medical expert reports, but "to date, no clear and convincing relationship (between PV and radiation) has been demonstrated." Initially, for the BVA to contend it explained "quite clearly" that it considered all the medical references in our brief, when many are not even mentioned in its decisions and none are discussed, is just ridiculous. Equally ridiculous is the BVA's adoption of a "clear and convincing" proof requirement.

The phrase "clear and convincing" is a term of art in the legal profession. It indicates a level of proof virtually indistinguishable from "beyond a reasonable doubt." Criminal cases must be proved "beyond a reasonable doubt," civil tax fraud cases by "clear and convincing" evidence, civil cases by a "preponderence of the evidence," and VA cases by "a reasonable probability as opposed to remote possibility or pure speculation." It is highly unfair and quite inconsistent with express VA policies to hold my mother or any other widow to the "clear and convincing" standard. Yet that is the level of proof the BVA required. Moreover, it then refused to consider the epidemiological data from Hiroshima or the Savannah River Plant. No legal explanation was provided.

The BVA's decision on reconsideration said it received additional evidence in 1981 which was not properly before it and "is therefore referred to the originating agency for initial consideration." Since we submitted no evidence in 1981, I realized the originating agency would be confused. Unfortunately, I was told by the Office of the Director of the VA Center in Philadelphia that I could not talk with the adjudication officer assigned to my case prior to his making a decision. On January 5, 1983, the adjudication officer refused to reopen mother's claim saying that the additional evidence submitted in 1981 "is a duplicate of the evidence that was already of record prior to the original BVA decision." When asked what "additional duplicative" evidence he considered, the adjudication officer listed various letters and reports which were attachments to a letter I sent to the BVA on August 14, 1980; not in 1981.

The BVA's decision on reconsideration in our case was so imprecise and uncommunicative that even the originating agency to which it was referred was unable to ascertain what evidence was considered by the Board. The final irony is that the BVA held "new" evidence was improperly before it and must be referred to the originating agency for consideration. The originating agency in refusing to reopen the claim held the "new" evidence was duplicative of evidence that had been considered by the BVA and therefore wasn't "new." Joseph Heller would love this. It provides a true life example of his fictional "Catch 22."

It appears to be virtually impossible to persuade the BVA to admit error. As discussed earlier, current medical data inconsistent with its prior decision was ignored and the level of causal connection demanded was increased from beyond "remote speculation" to "clear and convincing." Additionally, we believe mother has been denied the benefit of various pro-claimant regulations, and a favorable precedent.

In In re Coe, No, 78-34-01285 (1978), the BVA awarded benefits to a veteran. The Chairman of the BVA wrote "The ramifications of the Board's decision extend far beyond this one difficult case." We structured our arguments to come within the Coe precedent, and believe the facts in our case are significantly stronger than in Coe. The original BVA panel distinguished our case from Coe (two of the three panel members had been on the Coe panel), citing PV's easy diagnosis and its unexplained absence among the Japanese survivors. On reconsideration, we demonstrated that PV is difficult to diagnose, that considering its rarety a lack of reported cases among survivors of Hiroshima would be no more significant in mother's case than it was in Coe, and, finally, that there was evidence of increased PV in Hiroshima, just as there was in the Smoky test. I have since discovered that even the Atomic Bomb Casualty Commission in a 1966 study found increase PV among Hiroshima survivors. On reconsideration the BVA never addressed these facts. The evidence of record is such that were the Coe rational applied, the BVA should have allowed mother's claim. When the Coe rational proved inconvenient, however, it was simply abandoned without even a comment.

The VA regulations state that the agency is to enforce the law in a manner beneficial to veterans. According to 38 C.F.R. §3.102, veterans or their spouses need only show service connection "within the range of probability, as distinguished from pure speculation or remote possibility." The regulation goes on to say that reasonable doubts are to be resolved in favor of the claimants. These expressions of policy are necessarily subjective, and dependent for application on the good faith of the BVA. We submit however, that the facts of our case, where the doubts raised in filed briefs were either ignored or summarily dismissed, indicate that the benefit of these regulations were not granted to Anne Garr.

The VA also claims it will assist claimants, and 38 U.S.C. §3311 provides:

> - The Administrator...shall have authority to issue subpoenas for and can compell the attendance of witnesses...to aid claimants in the preparation and presentation of claims and to make investigations and examine witnesses upon any matter within the Jurisdiction of Veterans Administration.

Our research failed to uncover a single instance in which the VA exercised its subpoena power to assist a claimant in the preparation and presentation of a claim. We note that 38 C.F.R. §2.1 does not even delegate subpoena authority to the Board, and in 38 C.F.R. §19.135(a) the VA instructs the Board not to "require the appearance [at a hearing] of any Veterans Administration official or other person."

These regulations and the VA's failure to use its subpoena power to assist claimants under any circumstances appear to be inconsistent with the Congressional intent underlying 38 U.S.C. §3311. Moreover, the VA's failure to assist claimants is curiously inconsistent with its "statement of policy" found in 38 C.F.R. §3.103(a):

> It is the obligation of the Veterans Administration to assist a claimant in developing the facts pertinent of his claim....

One wonders if the BVA has ever stopped to consider why Congress wrote 38 U.S.C. §3311, and why 38 C.F.R. §3.103(a) was promulgated. In our case the Board went out of its way to advise the medical expert it relied upon that he was under no obligation to respond to any inquries we may make. What assistance

I would like to address one final matter that has troubled us. It concerns the dissemination of medical information. Last month I received a Fact Sheet dated March 1, 1982 which was prepared by the Defense Nuclear Agency. It summarizes the CDC data from the Smoky test and concludes:

> It should be noted that the cause of the lukemia has not been determined to be related to radiation received at the test. In addition, no increased mortality from other forms of cancer has been observed in this group...

Had the DNA identified a likely common denomimator other than radiation exposure at Smoky, it obviously would have been highlighted. The question boils down to what level of proof is needed to get the DNA or the VA to concede there is a relationship between the Smoky leukemias and radiation exposure. If the DNA and VA demand that the proof rise to the level of "certainty," it may never be proved to their satisfaction. The evidence gathered to date indicates a relationship is certainly much more likely than not.

Additionally, while the statement in the Fact Sheet that there has been no increased mortality from other cancers may be technically correct, it certainly is misleading. What about the huge [illegible]00% increase in PV among the Smoky veterans? Must we wait until the people die before the data is reported? One wonders what else isn't being reported; and what is more upsetting, one wonders why.

The BVA made a mistake in our case. In denying mother's claim it adopted a theory that was incompatible with the evidence of record. Even after the errors of law and fact were explained to an Expanded Board on reconsideration, the prior decision was affirmed. In affirming however, the BVA abandoned the landmark Coe precedent it had set only a few years earlier, refused to consider up-to-date medical reports, increased the level of proof demanded of the claimant to show service connection, reaffirmed its faith in a medical report notwithstanding the fact that the expert's underlying assumption that there was no PV found among Hiroshima survivors was demonstrated to be erroneous, and failed to grant my mother the benefit of its alleged policy of resolving reasonable doubts in favor of claimants. In this case everyone lost. The pity is that the BVA thinks that by denying mother's claim and preserving its record of not reversing itself it has won. Perhaps in a narrow sense it has. But I think both the Government and my mother have lost. For we truly proved her claim and the record reflects that fact.

A-Test Veterans Challenge Radiation-Disability Rules

A group of veterans who were involved with atomic testing and cleanup operations in World War II filed suit yesterday challenging the government's rules for compensation of physical disorders due to radiation exposure.

The suit, filed in U.S. District court here, claims that the Veterans Administration and the Defense Department approve the rules before interested parties, including scientists and the public, have an opportunity to comment.

The suit also says that the government strictly limits claims for such benefits to certain types of disorders it says could be related to radiation exposure.

For example, a radiation program guide put out by the VA for use by regional offices establishes eight types of cancer—but no other types of chronic effects of radiation exposure—that can be used as a basis for awarding disability benefits, the lawsuit alleges.

Since the rules went into effect last summer, all 220 radiation-related disability claims filed by veterans or their relatives have been denied by the government, the lawsuit said. Those veterans claimed, among other disabilities, tumors, degenerative bone and muscle disease, and genetic damage due to radiation exposure, the suit said. Overall, 98 percent of 490 radiation-related claims for veterans have been turned down, the suit said.

Yesterday's suit was filed by seven veterans, two widows of veterans, the National Association of Atomic Veterans Inc. and the Committee for U.S. Veterans of Hiroshima and Nagasaki. It asked the court to certify the case as a class action on behalf of more than 250,000 veterans and their families who may have a claim against the government as a result of radiation exposure.

The veterans asked the court to stop the VA from denying any claims until the government accepts full public comment on the rules for benefit awards.